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Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

ANTIMONY

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Synonyms: Antimony black, stibium, antimony powder

Chemical Formula: Sb

C.A.S. Number: 7440-36-0

Date Completed: 9/88

HAZARD SUMMARY

- Antimony can affect you when inhaled.
- Exposure can irritate the eyes, nose, throat and skin.
- High levels of exposure may lead to poisoning, with symptoms of nausea, headache, abdominal pain and death.
- The deadly gas stibine may be released in the presence of an acid.

GENERAL DESCRIPTION

Antimony is a silvery or gray, lustrous metal.

HEALTH HAZARD INFORMATION

Exposure to antimony may occur by inhalation, ingestion, skin contact or eye contact.

ACUTE (short-term) HEALTH EFFECTS

Exposure can cause eye, nose and throat irritation; nausea; and a metallic taste. Higher levels of exposure, especially by ingestion, can cause vomiting, diarrhea, labored breathing, congested lungs and heart irregularities.

Skin contact may cause irritation and may lead to small, red lesions, or "antimony spots".

Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

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PUBLICATION: #15,842-7pp-50cps 2/21/89 APPROVED BY: Ric Murphy, State Purchasing Agent

MA13.2:R245

CHRONIC (long-term) HEALTH EFFECTS

There is limited evidence that damage to the liver and heart, with an abnormal EKG, may occur with exposure to antimony.

An abnormal chest x-ray may develop in some cases. However, these changes are not thought to be harmful.

Cancer Hazard: Recent animal studies have shown antimony to be a probable carcinogen in rats. Studies have also shown an elevated lung cancer rate in workers exposed to antimony. These studies, however, have been poorly designed and extensively criticized. Therefore, at this time antimony can be considered a possible carcinogen.

Reproductive Hazard: Data are insufficient to determine any reproductive effects of antimony.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Not available.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is .5 mg/m^3, averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit is .5 mg/m^3, averaged over a 10-hour workshift.

ACGIH: The recommended airborne exposure limit is .5 mg/m^3, averaged over an 8-hour workshift.

MEDICAL MONITORING

Pre-employment and periodic medical histories and physical examinations should be performed on workers exposed to antimony. Lung function testing, an EKG, and urine test for antimony (and arsenic) should also be done. In cases of overexposure, an EKG, liver function tests, and chest x-ray may be helpful.

EMERGENCY INFORMATION

FIRST AID

Skin Contact: Remove contaminated clothing. Wash thoroughly with soap and water.

Ingestion: If the patient is conscious, vomiting should be induced. Seek immediate medical attention. Gastric lavage should be performed by qualified medical personnel.

Eye Contact: Irrigate the eyes with running water for at least 15 to 20 minutes, occasionally lifting upper and lower lids.

Inhalation: Move worker to fresh air. Perform artificial respiration if breathing has stopped. Seek immediate medical attention; the exposed worker should be under medical supervision for 24 to 48 hours to observe for delayed effects.

Antidote: Dimercaprol (BAL) can be given as an antidote to antimony poisoning. For maximal benefit, it must be given within a few hours of poisoning. This drug must be given under strict medical supervision.

FIRE AND EXPLOSION

NFPA Rating: Not Available

Extinguishing Media: Dry chemical, carbon dioxide, water spray or foam

Flash Point: Not Applicable

Flammable Limits: Not Available

Fire and Explosion Hazards: Finely divided antimony powder can present an explosion hazard.

Respiratory Protection: Use a self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive pressure mode.

Protective Equipment: Use structural firefighter's protective clothing, including helmet, coat, pants, boots and gloves, usually worn by firefighters.

Firefighting Procedures: Keep unnecessary people, isolate hazard area. Stay upwind. Move containers away from fire area if you can do so without risk.

SPILL, LEAK AND DISPOSAL PROCEDURES

Respiratory Protection: Any supplied-air respirator or self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with an auxilliary self-contained breathing apparatus operated in pressure demand or other positive-pressure mode.

Protective Equipment: Wear impervious protective clothing, gloves, and safety glasses, goggles or face shield.

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Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.

Large Spills: Dike far ahead of liquid spill for later disposal.

Disposal: Dispose of antimony metal according to all federal and state guidelines in an approved chemical waste landfill. Recovery and recycle is an option to disposal which should be considered for scrap antimony and spent catalysts containing antimony.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to antimony should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

The acceptable respirator types for antimony are shown in the following table:

Airborne Concentration or Condition of Use	Minimum Respiratory Protection Required above 0.5 mg/m^3
5 mg/m^3	- Any dust and mist respirator except single-use and quartermask respirators if not present as a fume. - Any supplied-air respirator. - Self-contained breathing apparatus.
12.5 mg/m^3	- Any powered air-purifying respirator with a dust and mist filter, if not present as a fume. - Any supplied-air respirator operated in a continuous flow mode.

Airborne Concentration or Condition of Use	Minimum Respiratory Protection Required above 0.5 mg m^3
25 mg/m^3	- Any air-purifying full facepiece respirator with a high-efficiency particulate filter. - Any powered air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter. - Any supplied-air respirator with a tight-fitting facepiece operated in a continuous flow mode. - Any self-contained breathing apparatus with a full facepiece. - Any supplied-air respirator with a full facepiece.
80 mg/m^3	- Any supplied-air respirator with a half-mask and operated in a pressure-demand or other positive-pressure mode.
Emergency or planned entry in unknown concentration or Immediately Dangerous to Life and Health Conditions	- See SPILL, LEAK AND DISPOSAL PROCEDURES
Firefighting	- See FIRE AND EXPLOSION
Escape	- Any appropriate escape-type self-contained breathing apparatus. - Any air-purifying full facepiece respirator with a high-efficiency particulate filter.

PROTECTIVE EQUIPMENT

Eye Protection: Use safety glasses, goggles or face shield.

Clothing: Wear impervious protective clothing to prevent repeated or prolonged skin contact.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Stable at normal pressure and temperature.

INCOMPATIBILITIES

Reacts violently with oxidizers, acids, halogenated acids, nitrates, halogens, peroxides and aluminum.

HAZARDOUS DECOMPOSITION PRODUCTS

Heating or contact with acids can produce toxic stibine fumes.

STORAGE

Store in a cool, dry area. Isolate from the incompatibilities listed above. Storage areas should be properly identified and secured. Containers should be inspected regularly for rust, corrosion and leakage.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 1635°C (2516°F)
Melting Point: 630.5°C (1202°F)
Vapor Pressure: 1 mmHg @ 886°C (1627°F)
Specific Gravity: 6.684 @ 25°C
Molecular Weight: 121.75
Solubility in Water: Insoluble
Evaporation Rate: Not applicable
Vapor Density: Not available

ADDITIONAL INFORMATION

Exposure to antimony may occur during mining, smelting, refining, alloy and abrasive manufacture, and typesetting in printing. A highly toxic gas, stibine, may be released from the metal under certain conditions, especially in the presence of an acid or acid mist.

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

The following information is available from the Massachusetts Department of Labor and Industries.

RIGHT TO KNOW INFORMATION

The Right to Know Program can answer questions about particular chemicals, training, labeling, and other Right to Know matters. Violations of the Right to Know Law should be reported to the nearest office of the Department of Labor and Industries.

PUBLIC PRESENTATIONS

Presentations and educational programs on occupational health or the Right to Know Law can be given for labor unions, trade associations and other groups.

OCCUPATIONAL HEALTH AND SAFETY SERVICES

Upon recept of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

The Division of Occupational Hygiene has the names of various occupational health services and occupational physicians who are board-certified. This information is available upon request.

MASSACHUSETTS DEPARTMENT OF LABOR AND INDUSTRIES

Division of Occupational Hygiene

West Newton (617) 969-7177

Division of Industrial Safety

Boston (617) 727-3460
Lawrence (617) 681-7798
New Bedford (617) 997-8263
Springfield (413) 734-1421
Worcester (617) 752-6504
Pittsfield (413) 445-4214

MASS. MA13.2:R245/Ars Arsenic

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

ARSENIC

(inorganic)

GOVERNMENT DOCUMENTS COLLECTION MAY 3 1990 University of Massachusetts Depository Copy

Synonyms: arsenicals, arsenic-75
C.A.S. Number: 7440-38-2
Chemical Formula: As
Date Completed: 9/89

HAZARD SUMMARY

- Arsenic can affect you when breathed in, through ingestion, or by passing through your skin.
- Arsenic causes cancer of the skin and lungs.
- Arsenic may damage the developing fetus.
- Arsenic can cause skin changes, including irritation, thickening and discoloration.
- Prolonged exposure to arsenic may damage the nervous system, causing numbness in the arms and legs and weakness. It may affect the blood forming cells.

GENERAL DESCRIPTION

Arsenic is a metal found abundantly in nature, often as an impurity in other metal ores. Arsenic and its compounds are used in pesticides, weed killers, anti-fouling paints, metal alloys, special glasses and enamels, and in the manufacture of semiconductor devices and integrated circuits.

HEALTH HAZARD INFORMATION

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Breathing arsenic can irritate the nose and respiratory tract. Exposure to high levels may cause severe damage to the respiratory system with symptoms of cough, shortness of breath and chest pain, as well as nausea and vomiting.

Skin Contact: Arsenic compounds may irritate the skin, causing burning, itching, and a rash.

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1001 Watertown Street, West Newton, MA 02165

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APPROVED BY: Ric Murphy, State Purchasing Agent

Eye Contact: Exposure to arsenic may irritate the eyes causing conjunctivitis.

Ingestion: Ingestion of arsenic affects the gastrointestinal tract leaving a metallic taste and causing nausea, vomiting, and diarrhea.

CHRONIC (long-term) HEALTH EFFECTS

Inhalation: Long-term exposure may cause nausea, vomiting, diarrhea, fainting, and weakness. Discoloration and thickening of the skin and white lines on the fingernails may occur. Chronic poisoning with arsenic can interfere with the production of blood cells by the bone marrow and cause anemia. Nerve damage, with complaints of burning, numbness, "pins and needles," and weakness of arms and legs, may result from high or repeated exposure to arsenic. Prolonged exposure may cause an ulcer or hole in the tissue dividing the nose.

Skin Contact: Repeated exposure to arsenic may cause skin allergy, thickened skin, and areas of darkened or de-pigmented skin. White lines in the fingernails may appear.

Eye Contact: Repeated or prolonged exposure to arsenic dust may cause conjunctivitis.

Ingestion: Long-term exposure to arsenic can damage the nervous system, with a "pins and needles" sensation of the arms and legs, numbness and weakness.

Cancer Hazard: Arsenic compounds have been shown to cause skin and lung cancer in humans. Data are inadequate to evaluate the risk for other types of cancer. (One study has indicated that arsenic can cross the placenta in pregnant rodents and cause cancer in the offspring - this needs to be documented.)

Reproductive Hazard: Birth malformations and low birthweight may occur in the infants of mothers exposed to arsenic. Arsenic should be considered a potential reproductive toxin. It may also appear in breast milk.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Not available.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations, made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 0.01 mg/m^3, averaged over an 8-hour workshift. In addition, the OSHA Standard has specific requirements for air monitoring, medical surveillance, engineering controls and respiratory protection. The number of the standard is 29 CFR 1910.1018 and should be used as a reference for specific details when arsenic is used in the workplace.

NIOSH: The recommended short-term exposure limit, not to be exceeded during any 15-minute period, is 0.002 mg/m^3.

ACGIH: The recommended airborne exposure limit is 0.2 mg/m^3, averaged over an 8-hour workshift.

MEDICAL MONITORING

According to the OSHA Standard 1910.1018, employees exposed above the "action level" for at least 30 days per year must be provided with an initial and periodic medical examination. The exam must include a work history; a medical history including a smoking history; a chest X-ray; and nasal, skin, and nervous system examination. A test for urine arsenic (do not obtain within two days of eating fish or shellfish) should not be greater than 100 micrograms per liter. Arsenic-exposed individuals should periodically examine their skin. Skin cancer from arsenic can easily be cured when detected early.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Remove the individual from exposure area to fresh air immediately. If breathing has ceased, properly trained personnel should begin artificial respiration or cardiopulmonary resuscitation immediately. Get medical help immediately.

Skin Contact: Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water until no evidence of chemical remains (about 15 to 20 minutes). Get medical help immediately.

Eye Contact: Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (about 15 to 20 minutes). Get medical help immediately.

Ingestion: Remove by gastric lavage or inducing vomiting, unless individual is unconscious. Give oxygen if respiration is depressed. Administration of gastric lavage or oxygen should be done by qualified medical personnel.

Contact the local poison control center for information on antidotes.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 0
Reactivity: 0
Health: 3

Flash point: NA
Autoignition Temp.: NA
Extinguishing Media: NA
Flammable Limits: NA

Respiratory Protection: Any full-facepiece, self-contained breathing apparatus operated in positive-pressure mode.

Protective Equipment: Impervious clothing, including gloves, to prevent skin contact.

SPILL, LEAK, DISPOSAL PROCEDURES

For spills of dry solid material, a clean shovel should be used to place the material in a clean, dry container with a cover. The hazard area should be isolated. For wet or solution spills, sand or other absorbent material should be added, and the mixture transferred into containers. For spills of liquid compounds such as arsenic trichloride, a holding area should be dug and diked with soil, sandbags, or foamed polyurethane. Fly ash or cement powder may be added as absorbent. If the spill took place in water, a neutralizing agent such as calcium hypochlorite, lime, limestone, or sodium bicarbonate should be added.

Disposal: Elemental arsenic should be placed in long-term storage or returned to the supplier for reprocessing. Arsenic trichloride should be passed through water to form arsenic trioxide; scrubbers must be used to trap hydrogen chloride. The trioxide should be placed in long-term weatherproof storage, or dissolved, precipitated as the sulfide, and returned to the supplier.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to inorganic arsenic should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

The following respirators are the minimum legal requirement:

Airborne Arsenic Concentration	Required Respirator
less than 0.1 mg/m^3	Half-mask respirator with high-efficiency filter and acid gas cartridge
less than 0.5 mg/m^3	Full-facepiece supplied-air respirator or self-contained breathing apparatus or gas mask equipped with high-efficiency filters and acid-gas canister
less than 10 mg/m^3	Half-mask supplied-air respirator operated in positive-pressure mode
less than 20 mg/m^3	Supplied-air respirator with full facepiece, hood, or helmet, or suit operated in positive-pressure mode
Unknown or greater than 20 mg/m^3	Any full-facepiece self-contained breathing apparatus operated in positive-pressure mode

PROTECTIVE EQUIPMENT

Eye Protection: Eye protection must comply with OSHA requirement 29 CFR 1910.1018 (j). For liquid compounds, splash-proof goggles and a faceshield must be worn. An eye-wash fountain must be available.

Clothing: Clothing must comply with OSHA requirement 29 CFR 1910.1018 (j). For liquid compounds, impervious clothing and gloves must be worn to prevent skin contact.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY INFORMATION

Stable under normal temperatures and pressures.

INCOMPATIBILITIES

Arsenic and its solid compounds react vigorously with acids, oxidizing agents, active metals, fluorine, and hydrogen fluoride. Liquid compounds such as arsenic trichloride explode under these conditions, and on impact with antimony compounds.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition may release toxic oxides of arsenic and highly toxic arsine gas.

STORAGE

Arsenic and its compounds should be stored in a cool, dry location, with containers protected against physical damage.

PHYSICAL AND CHEMICAL DATA

Elemental Arsenic:

Boiling Point: 1135°F (sublimes)
Melting Point: 814°F (36 atm.) (sublimes)
Vapor Pressure: 1 mmHg at 372°F
Specific Gravity (water=1): 5.6

Molecular Weight: 74.92
Solubility in Water: insoluble
Evaporation Rate: NA
Vapor Density: NA

Arsenic Trioxide:

Boiling Point: 869 F (465°C)
Melting Point: 594 F (312°C)
Vapor Pressure: NA
Specific Gravity (water=1): 3.74

Molecular Weight: 197.84
Solubility in Water: 3.7%
Evaporation Rate: NA
Vapor Density: NA

Arsenic Trichloride:

Boiling Point: 266°F (130°C)
Melting Point: 3°F (-16°C)
Vapor Pressure: 10 mmHg at 24°C
Specific Gravity (water=1): 2.2

Molecular Weight: 181.3
Solubility in Water: decomposes
Evaporation Rate: NA
Vapor Density: NA

ADDITIONAL INFORMATION

Arsenic is a metal found abundantly in nature, often mixed with other metal ores. Arsenic and its compounds are dangerous when heated, on contact with acids or oxidizing agents, or in the form of dust that can be inhaled.

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

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PUBLIC PRESENTATIONS

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OCCUPATIONAL HEALTH AND SAFETY SERVICES

Upon recept of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

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Pittsfield (413) 445-4214

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Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

BENZENE

Synonyms: Benzole, phene, pyrobenzol, carbon oil, phenyl hydride, coal tar naphtha, benzolene

Chemical Formula: C_6H_6

Date Completed: 4/88

C.A.S. Number: 71-43-2

HAZARD SUMMARY

- Benzene is a known carcinogen - it can cause leukemia.
- Exposure can cause dizziness and headaches. At higher levels it can lead to convulsions and death.
- Benzene can cause irregular heart beat.
- Exposure to benzene can cause anemia.
- Benzene can irritate the eyes, nose and throat.
- Air levels of benzene that are toxic may not be detectable by smell.

GENERAL DESCRIPTION

Benzene is a highly volatile, colorless liquid with an agreeable odor, that is obtained from coal tar or petroleum. Benzene is most commonly used as an intermediate in the manufacture of many chemicals. It is also used as a solvent and a thinner, and may be present in paint and varnish removers, rubber cements and lacquers.

HEALTH HAZARD INFORMATION

Exposure to benzene can occur by inhalation, ingestion, eye contact, and skin contact.

ACUTE (short-term) HEALTH EFFECTS

Exposure to benzene can cause symptoms of central nervous system depression including drowsiness, dizziness, lightheadedness, headache, vomiting, seizures, coma and death. A large exposure can cause a fatal irregular heartbeat (ventricular fibrillation).

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1001 Watertown Street, West Newton, MA 02165

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Eye Contact: Benzene can cause eye irritation.

Skin Contact: Benzene is poorly absorbed through unbroken skin. Skin contact with benzene can result in skin irritation with redness, blisters, dryness and scaling.

Inhalation: Inhalation of benzene can cause nose and throat irritation.

CHRONIC (long-term) HEALTH EFFECTS

Long-term exposure to benzene may result in aplastic anemia. Chronic exposure can cause bone marrow toxicity which results in low blood counts; this can result in infection, shortness of breath, pallor, fatigue, bleeding and bruising. Workers with benzene-induced marrow injury should be removed from benzene exposure permanently. Long-term skin contact with benzene can cause dryness and scaling of skin.

Cancer Hazard:

Benzene is a known cancer-causing agent. It has been shown to cause leukemia.

Reproductive Hazard:

In experimental studies, benzene has been shown to cause toxicity in the offspring of exposed animals. This has included decreased weight, increases in skeletal variation such as extra ribs, and abnormalities in blood cell formation. Benzene has been shown to cause chromosomal damage in humans, animals and cells in culture. There is insufficient information to determine birth defects or any other effects in humans.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

There are no significant medical problems that are aggravated by benzene exposure.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne limit is 1 ppm, averaged over an 8-hour workday. The maximum short-term exposure limit is 5 ppm for any 15-minute period. The action level is 0.5 ppm. Above this concentration, an employer must implement provisions of the OSHA standard specified in federal regulations 29 CFR 1910.1028.

ACGIH: The recommended exposure limit is 10 ppm, averaged over an 8-hour workday.

NIOSH: The recommended limit is 0.1 ppm averaged over an 8-hour workday. The recommended ceiling limit is 1 ppm for any 15-minute period.

Because benzene is a carcinogen, it should never be used if it is possible to substitute less toxic substances.

MEDICAL MONITORING

According to Federal Law (29 CFR 1910.1028) workers who are exposed to specified levels of benzene must have pre-employment and periodic medical histories and physical examinations: a complete blood count must be done at that time. If a worker is required to use a respirator, then pulmonary function testing must be done as well. Emergency examinations must be done as warranted; the emergency examination must include measurement of urinary phenol. For more specific details of mandatory medical monitoring, consult 29 CFR 1910.1028.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Move patient to fresh air. If patient is not breathing, begin artificial respiration immediately. Seek immediate medical attention.

Skin Contact: Immediately wash skin with soap and water until no traces of benzene remain. Wash contaminated clothing prior to wearing it.

Eye Contact: Irrigate eyes with running water for at least ten to fifteen minutes, or until no traces of benzene remain. Seek medical attention if irritation persists or if vision is impaired.

Ingestion: Seek immediate medical attention. Do not induce vomiting.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 3
Reactivity: 0
Health: 2

Flash Point: -11°C (12°F)
Flammable Limits: upper - 7.9%; lower - 1.3%
Extinguishing Media: dry chemical, CO_2, water spray, or foam

Respiratory Protection: For firefighting, full-facepiece self-contained breathing apparatus in positive-pressure mode should be used.

SPILL, LEAK AND DISPOSAL PROCEDURES

As much of the spilled benzene as possible should be absorbed with suitable materials, such as dry sand or earth. Materials such as cement powder, sawdust, or commercial sorbents may also be used. The remaining benzene should be flushed with large amounts of water, but not into a confined space, such as a sewer, because of explosion hazard. All potential ignition sources must be removed.

If the spill occurs over a body of water, barriers should be used to limit spreading of the benzene. Detergents, alcohols, or surface-active agents should be applied to thicken the spilled material, then a gelling agent to immobilize the spill and to facilitate removal with suction or dredges.

Disposal methods must conform to federal, state and local regulations. If allowed, benzene may be disposed of: a) by absorbing in dry sand or earth and placing in a sanitary landfill; b) if in small quantities, by removing it to a safe location, pouring it into dry sand or earth, and igniting it; c) if in large quantities, by atomizing it in a suitable combustion chamber.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are better than personal protective equipment. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Improper use of respirators can be dangerous. Only respirators that have been approved by NIOSH or MSHA for exposures to benzene should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation.

The acceptable respirator types for benzene are shown in the following table:

Airborne Concentration or Condition of Use	Minimum Respiratory Protection
10 ppm or less	Half-mask air-purifying respirator with organic vapor cartridge
50 ppm or less	Full-facepiece respirator with organic vapor cartridge
100 ppm or less	Full-facepiece powered air-purifying respirator with organic vapor canister
1000 ppm or less	Supplied-air respirator with full-facepiece in positive-pressure mode

Airborne Concentration or Condition of Use	Minimum Respiratory Protection
higher than 1000 ppm or unknown concentration	Self-contained breathing apparatus with full-facepiece in positive-pressure mode; or full-facepiece positive-pressure supplied-air respirator with auxiliary self-contained air supply
Escape	Any organic vapor gas mask or any self-contained breathing apparatus with full-facepiece.

PROTECTIVE EQUIPMENT

Personal protective clothing, such as boots, gloves, sleeves, and aprons should be worn to limit exposure to liquid benzene. Eyes should be protected with splash-proof safety goggles. A face shield should be worn if there is danger of splashing of liquid benzene.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Benzene is stable under normal temperatures and pressure.

INCOMPATIBILITIES

Avoid contact with heat and oxidizing materials.

HAZARDOUS DECOMPOSITION PRODUCTS

Toxic gases such as carbon monoxide.

STORAGE

Benzene containers should be protected against physical damage. Outside or detached storage is preferable. Inside storage should be in a standard flammable-liquids storage room or cabinet, with isolation from oxidizing materials.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 176°F (80°C)
Melting Point: 42°F (6°C)
Vapor Pressure: 74.6 mmHg at 20°C
Specific Gravity (water=1): 0.9
Molecular Weight: 78.08
Solubility in Water: 0.18% at 25°C
Evaporation Rate (CCl_4 = 1): 1.0
Vapor Density: 2.8

ADDITIONAL INFORMATION

Benzene should not be confused with benzine, which is a name used for certain grades of petroleum naphtha similar to gasoline. Gasoline may contain up to two percent of benzene. Because of its toxicity, benzene has been replaced in recent years by substances such as toluene or naphtha for many solvent applications.

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

The following information is available from the Massachusetts Department of Labor and Industries.

RIGHT TO KNOW INFORMATION

The Right to Know Program can answer questions about particular chemicals, training, labeling, and other Right to Know matters. Violations of the Right to Know Law should be reported to the nearest office of the Department of Labor and Industries.

PUBLIC PRESENTATIONS

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OCCUPATIONAL HEALTH AND SAFETY SERVICES

Upon receipt of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

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Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

CARBON TETRACHLORIDE

Synonyms: Tetrachloromethane, Tetrachlorocarbon, Freon 10
Chemical Formula: CCl_4
C.A.S. Number: 56-23-5
Date Completed: 3/89

HAZARD SUMMARY

- **Carbon tetrachloride can affect you when inhaled, swallowed, or splashed on the skin or in the eye.**
- **Carbon tetrachloride may cause cancer and affect reproduction.**
- **Carbon tetrachloride can damage the liver and kidneys.**
- **When carbon tetrachloride comes in contact with welding arcs, flames or hot metal surfaces, poisonous phosgene and hydrogen chloride gases are produced.**
- **Exposure to carbon tetrachloride may cause drowsiness, dizziness, abdominal pain, nausea and vomiting. It may even cause unconsciousness, irregularities in heart rhythm and death.**

GENERAL DESCRIPTION

Carbon tetrachloride is a colorless liquid with an ether-like odor. Although it has been banned for use in the home, it is still used as an industrial solvent, in the manufacture of chlorinated organic compounds, and as a grain fumigant.

HEALTH HAZARD INFORMATION

Exposure to carbon tetrachloride may occur by inhalation, ingestion, skin contact and eye contact.

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Acute exposure to carbon tetrachloride may lead to drowsiness, dizziness, incoordination, abdominal pain, nausea, vomiting and diarrhea. Exposure to higher levels may cause unconsciousness and may make the

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #15,883-6pp-50cps 3/29/89
APPROVED BY: Ric Murphy, State Purchasing Agent

heart beat irregularly. (At 300 ppm, it can cause death.) Delayed effects from short-term overexposure include damage to the heart, liver and kidneys. (Symptoms of liver damage include yellowish coloring of the skin and dark colored urine.)

Ingestion: The ingestion of even small amounts of carbon tetrachloride can cause the same symptoms as those seen with inhalation.

Eye Contact: Contact with the liquid or vapor may cause eye pain.

Skin Contact: Contact with liquid carbon tetrachloride may cause mild irritation. It may be absorbed and can cause symptoms like those from inhalation.

CHRONIC (long-term) HEALTH EFFECTS

Inhalation: Prolonged or repeated exposure may cause liver and kidney damage. Symptoms may include fatigue, loss of appetite, abdominal pain, nausea and vomiting. There is a strong indication that exposure causes decreased vision and disturbances in color vision.

Skin Contact: Repeated or prolonged contact of the liquid with the skin may cause irritation. It can be absorbed, causing symptoms like those from inhalation.

Eye Contact: Absorption through the eyes may cause effects like those caused by inhalation.

Cancer Hazard: Carbon tetrachloride is a probable carcinogen in humans. It has been shown to cause liver cancer in rodents.

Reproductive Hazard: Information is lacking on the reproductive effects of carbon tetrachloride in humans. In experimental studies with rodents, large toxic doses have had harmful effects on the reproductive systems of males and females and on the offspring of exposed females. Limited studies have shown that carbon tetrachloride causes mutations in cell test systems.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Underlying liver and kidney disease may be aggravated by exposure.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations, made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 2 ppm, averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit is 2 ppm, averaged over a one-hour period.

ACGIH: The recommended airborne exposure limit is 5 ppm, averaged over an 8-hour workshift.

MEDICAL MONITORING

Pre-employment medical exams should include liver and kidney function tests and a urinalysis. They should be repeated annually. Emergency examinations must be done as warranted.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Remove from exposure area to fresh air immediately. If breathing has stopped, perform artificial respiration. Get medical attention immediately.

Ingestion: Induce vomiting with ipecac syrup unless the patient is not awake or is having seizures. Get immediate medical attention.

Skin Contact: Remove contaminated clothing and shoes immediately. Wash affected areas with soap or mild detergent and large amounts of water until no evidence of the chemical remains (approximately 15-20 minutes). Get medical attention if the area is painful or if the individual is complaining of any symptoms.

Eye Contact: Wash eyes immediately with a stream of water for 15 minutes or longer, making sure the victim's eyelids are held wide apart and no evidence of the chemical remains. Get medical attention if irritation persists or if vision is impaired.

FIRE AND EXPLOSION

NFPA Rating	
Flammability: 0	Flash Point: NA
Reactivity: 0	Extinguishing Media: Dry chemical, CO_2, water spray, or foam
Health: 3	Flammable Limits: NA

Respiratory Protection: Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive-pressure mode.

Protective Equipment: Impervious clothing, including gloves, face shields, and other appropriate clothing (made of nitrile, PVA or viton) to prevent contact with liquid carbon tetrachloride.

Special Precautions: Although carbon tetrachloride is not flammable, it can decompose at high temperature to generate highly toxic phosgene gas and other toxic and irritating products.

SPILL, LEAK AND DISPOSAL PROCEDURES

Stop leaks if it can be done without risk. Use water spray to reduce vapors. For small spills, take up with sand or other absorbent material and place into containers for disposal. For larger spills, dike far ahead to contain the liquid. Suction hoses may be used to remove the contained liquid. Isolate the hazard area, and ventilate closed areas before entering.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to carbon tetrachloride should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

At any detectable airborne concentration, either of the following respirators should be used:

- Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode.

- Supplied-air respirator with full facepiece, operated in pressure-demand or other positive-pressure mode, in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

For escape, any gas mask providing protection against organic vapors, or any escape self-contained breathing apparatus may be used.

PROTECTIVE EQUIPMENT

Eye Protection: Splash-proof safety goggles and a faceshield must be worn to prevent contact with carbon tetrachloride.

Clothing: Appropriate impervious clothing (made of nitrile, PVA or viton), including gloves, must be worn to prevent repeated or prolonged skin contact.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Carbon tetrachloride is stable at normal temperatures and pressures.

INCOMPATIBILITIES

Explodes or reacts violently on heating or impact in the presence of many metals, such as sodium, potassium, uranium, aluminum, or barium. May react explosively when heated with substances such as liquid oxygen, calcium hypochlorite, calcium disilicate, decaborane, wax, fluorine, ethylene, and allyl alcohol.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition of carbon tetrachloride may form toxic and hazardous phosgene, oxides of carbon, chlorine, and hydrogen chloride.

STORAGE

Protect against physical damage. Store containers in a cool, dry, well-ventilated location, away from fire hazards.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 172°F (78°C)
Melting Point: -9°F (-23°C)
Vapor Pressure: 91.3 mmHg at 20°C
Specific Gravity: 1.58

Molecular Weight: 153.84
Solubility in Water: 0.08%
Evaporation Rate (butyl acetate = 1): 12.8
Vapor Density: 5.3

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

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A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

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PUBLIC PRESENTATIONS

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OCCUPATIONAL HEALTH AND SAFETY SERVICES

Upon recept of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

The Division of Occupational Hygiene has the names of various occupational health services and occupational physicians who are board-certified. This information is available upon request.

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MASS MA 13.2: R 245/2/CHEM

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

2-ETHOXYETHANOL

(cellosolve)

Synonyms: Cellosolve, Ethylene Glycol Monoethyl ether, Dowanol EE
Chemical Formula: $C_4H_{10}O_2$
Date Completed: 8/90
C.A.S. Number: 110-80-5

HAZARD SUMMARY

- **2-Ethoxyethanol can affect you when inhaled or absorbed through the skin.**
- **2-Ethoxyethanol can harm the reproductive systems of men and women by damaging the testes and/or the developing fetus.**
- **Prolonged exposure to 2-ethoxyethanol may result in anemia and a reduced white blood cell count.**

GENERAL DESCRIPTION

2-Ethoxyethanol is a colorless liquid with a mild, sweetish odor. It is widely used as a solvent, an anti-icing additive in brake fluids, and an additive in aviation and automobile fuels.

HEALTH HAZARD INFORMATION

Exposure to 2-ethoxyethanol may occur by inhalation, ingestion, or skin contact.

ACUTE (short-term) HEALTH EFFECTS

2-Ethoxyethanol can irritate the eyes, nose, throat and lungs, causing cough and/or shortness of breath.

2-Ethoxyethanol can dissolve the skin's natural protective oils, causing dryness, redness, flaking, cracking and dermatitis.

Higher levels of exposure may cause dizziness, disorientation, sluggishness, fatigue and headache.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

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APPROVED BY: Ric Murphy, State Purchasing Agent

CHRONIC (long-term) HEALTH EFFECTS

Prolonged exposures can cause anemia, low white blood cell count, depression of the bone marrow and possible suppression of the immune system.

Continued exposure may result in persistent headache, confusion, personality changes and a decline in intellectual function.

Repeated exposures may cause kidney damage.

Cancer Hazard: No information is currently available regarding 2-ethoxyethanol's ability to cause cancer.

Reproductive Hazard: Animals exposed to 2-ethoxyethanol have had decreased sperm count and abnormally-shaped sperm. Animal studies have also shown 2-ethoxyethanol to harm the offspring. 2-Ethoxyethanol has been shown to decrease the size of testicles in men working with the substance.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

There are no specific conditions aggravated by exposure to 2-ethoxyethanol.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations, made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The permissible airborne exposure limit is 200 ppm, averaged over an 8-hour workshift.

ACGIH: The recommended limit is 5 ppm, averaged over an 8-hour workshift.

NIOSH: The recommended limit is the lowest possible concentration.

The above exposure limits are for airborne levels only. When skin contact also occurs, one may become overexposed even though the airborne levels are less than the limits given above.

MEDICAL MONITORING

Those workers with frequent or potentially high exposure to 2-ethoxyethanol should receive a complete physical examination, including an occupational and medical history, at the beginning of employment and regularly therafter. This test should include a complete blood count, a kidney function evaluation, and a reproductive system assessment.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Move the patient to fresh air immediately. If breathing has stopped, perform artificial respiration. Keep the person warm and at rest. Seek immediate medical attention.

Ingestion: Administer an emetic or use gastric lavage only if the patient is conscious. Give oxygen if respiration is depressed. These procedures should be done only by qualified medical personnel.

Skin: Remove contaminated clothing and shoes. Wash affected areas with soap and large amounts of water for at least 15 minutes. Get medical attention immediately.

Eyes: Wash the eyes immediately with large amounts of water, occasionally lifting upper and lower lids, for at least 15 minutes. Get medical attention immediately.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 2
Reactivity: 0
Health: 2

Flash Point: 110°F (43°C)
Autoignition Temp: 455°F (235°C)
Extinguishing Media: Dry chemical, carbon dioxide; water spray; alcohol foam
Flammable Limits: lower - 1.7%; upper - 15.6%

Respiratory Protection: Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode.

Protective Equipment: Impervious clothing and gloves to prevent skin contact.

Special Precautions: Move containers from fire area if possible. Cool fire-exposed containers with water from the side until after the fire is out.

SPILL, LEAK, AND DISPOSAL PROCEDURES

All ignition sources should be shut off, and the area of the spill or leak should be ventilated. Persons not wearing protective equipment should be kept away.

Small Spills: Absorb the liquid with fly ash, cement powder, or similar absorbent material, and deposit in sealed containers.

Large Spills: Dig a holding area such as a pit or lagoon to contain the spill, and dike surface flow with a barrier of soil, sandbags, or foamed polyurethane.

Disposal: Discharge the liquid at a controlled rate near a pilot flame to incinerate.

A release of more than one pound of 2-ethoxyethanol must be immediately reported to the Local Emergency Planning Committee, the State Emergency Response Commission, and the National Response Center (800-424-8802).

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to 2-ethoxyethanol should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

For any detectable airborne level, either of the following should be used:

Any self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode;

Any supplied-air respirator with full facepiece, operated in pressure-demand or other positive-pressure mode, in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

PROTECTIVE EQUIPMENT

Eye Protection: Splash-proof safety goggles and a faceshield.

Clothing: Impervious clothing, including gloves, to prevent contact of the liquid with the skin.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

2-Ethoxyethanol is stable at normal temperatures and pressures. It may decompose on prolonged exposure to light.

INCOMPATIBILITIES

Forms explosive compounds in contact with strong oxidizers, acids, and alkalies. May corrode aluminum, magnesium, or zinc. May attack plastics and rubber coatings.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition produces toxic gases and vapors, including carbon monoxide.

STORAGE

Store in tightly closed containers in a cool, well ventilated area away from heat and all sources of ignition.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 275°F (135°C)
Melting Point: -94°F (-70°C)
Vapor Pressure: 3.8 mmHg at 68°F
Specific Gravity: 0.93

Molecular Weight: 90.12
Solubility in Water: soluble
Evaporation Rate (Butyl acetate=1): 0.32
Vapor Density: 3.0

DEFINITIONS

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MASS MA 13.2: R 245/2/CHEM

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

2-ETHOXYETHANOL ACETATE

(cellosolve acetate)

Synonyms: Cellosolve acetate, Ethylene Glycol Monoethyl Ether Acetate, 2-Ethoxyethyl Acetate, Polysolv EE Acetate

C.A.S. Number: 111-15-9

Chemical Formula: $C_6H_{12}O_3$

Date Completed: 8/90

HAZARD SUMMARY

- 2-Ethoxyethanol acetate can affect you when inhaled or absorbed through the skin.
- 2-Ethoxyethanol acetate can harm the reproductive systems of men and women by damaging the testes and/or the developing fetus.
- Long-term exposure to 2-ethoxyethanol acetate may cause anemia or damage to the kidneys.

GENERAL DESCRIPTION

2-Ethoxyethanol acetate is a colorless liquid with a mild odor and a bitter taste. It is used as a solvent for many different purposes.

HEALTH HAZARD INFORMATION

Exposure to 2-ethoxyethanol acetate may occur by inhalation, ingestion, or skin contact.

ACUTE (short-term) HEALTH EFFECTS

2-Ethoxyethanol acetate can irritate the eyes, nose, throat and lungs, causing cough and/or shortness of breath.

2-Ethoxyethanol acetate can dissolve the skin's natural protective oils, causing dryness, redness, flaking, cracking and dermatitis.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #16,393 - 6pp. - 50cps. - 7/23/90
APPROVED BY: Ric Murphy, State Purchasing Agent

Higher levels of exposure may cause dizziness, disorientation, sluggishness, fatigue and headache.

CHRONIC (long-term) HEALTH EFFECTS

Prolonged exposures can cause anemia, low white blood cell count, depression of the bone marrow and possible suppression of the immune system.

Continued exposure may result in persistent headache, confusion, personality changes and a decline in intellectual function.

Repeated exposures may cause kidney damage.

Cancer Hazard: No information is currently available regarding 2-ethoxyethanol acetate's ability to cause cancer.

Reproductive Hazard: Animals exposed to 2-ethoxyethanol acetate have had decreased sperm count and abnormally-shaped sperm. Animal studies have also shown 2-ethoxyethanol acetate to harm the offspring. 2-Ethoxyethanol acetate has been shown to decrease the size of testicles in men working with the substance.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

There are no specific conditions aggravated by exposure to 2-ethoxyethanol acetate.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations, made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The permissible airborne exposure limit is 100 ppm, averaged over an 8-hour workshift.

ACGIH: The recommended limit is 5 ppm, averaged over an 8-hour workshift.

The above exposures are for airborne levels only. When skin contact also occurs, one may become overexposed, even though the airborne levels are less than the limits given above.

MEDICAL MONITORING

Workers with frequent or potentially high exposure to 2-ethoxyethanol acetate should receive a complete physical examination, including an occupational and medical history, at the beginning of employment and regularly thereafter. This test should include a complete blood count, a kidney function evaluation, and a reproductive system assessment.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Move the patient to fresh air immediately. If breathing has stopped, perform artificial respiration. Keep the person warm and at rest. Get medical attention immediately.

Ingestion: Administer an emetic or use gastric lavage only if the patient is conscious. Give oxygen if respiration is depressed. These procedures should be done only by qualified medical personnel.

Skin: Remove contaminated clothing and shoes. Wash affected areas with soap and large amounts of water for at least 15 minutes. Get medical attention immediately.

Eyes: Wash the eyes immediately with large amounts of water, occasionally lifting upper and lower lids, for at least 15 minutes. Get medical attention immediately.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 2	Flash Point: 117°F (47°C)
Reactivity: 0	Autoignition Temp: 716°F (380°C)
Health: 1	Extinguishing Media: Dry chemical; carbon dioxide; water spray; alcohol foam
	Flammable Limits: lower - 1.7%; upper - 13%

Respiratory Protection: Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode.

Protective Equipment: Impervious clothing and gloves to prevent skin contact.

Special Precautions: Move containers from fire area if possible. Cool fire-exposed containers with water from the side until after the fire is out.

SPILL, LEAK, AND DISPOSAL PROCEDURES

All ignition sources should be shut off, and the area of the spill or leak should be ventilated. Persons not wearing protective equipment should be kept away.

Small Spills: Absorb the liquid with fly ash, cement powder, or similar absorbent material, and deposit in sealed containers.

Large Spills: Dig a holding area such as a pit or lagoon to contain the spill, and dike surface flow with a barrier of soil, sandbags, or foamed polyurethane.

Disposal: Discharge the liquid at a controlled rate near a pilot flame to incinerate.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to 2-ethoxyethanol acetate should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

The acceptable respiratory protection depends on the airborne level of 2-ethoxyethanol acetate, as follows:

up to 50 ppm -	Any supplied-air respirator or self-contained breathing apparatus
up to 125 ppm -	Any supplied-air respirator operated in a continuous-flow mode
up to 250 ppm -	Any self-contained breathing apparatus or supplied-air respirator with a full facepiece
up to 2500 ppm -	Any self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode
Escape -	Any air-purifying full-facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister.

PROTECTIVE EQUIPMENT

Eye Protection: Splash-proof safety goggles.

Clothing: Impervious clothing, including gloves, to prevent contact of the liquid with the skin.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

2-Ethoxyethanol acetate is stable at normal temperatures and pressures.

INCOMPATIBILITIES

Forms explosive compounds in contact with strong oxidizers, acids, alkalis, and nitrates.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition produces acrid smoke and toxic fumes, including carbon monoxide.

STORAGE

Store in tightly closed containers in a cool, well ventilated area, away from heat and all sources of ignition.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 313°F (156°C)
Melting Point: -80°F (-62°C)
Vapor Pressure: 2mmHg at 20°C
Specific Gravity: 0.9

Molecular Weight: 132.16
Solubility in Water: 23%
Evaporation Rate: NA
Vapor Density: 4.6

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

The following information is available from the Massachusetts Department of Labor and Industries.

RIGHT TO KNOW INFORMATION

The Right to Know Program can answer questions about particular chemicals, training, labeling, and other Right to Know matters. Violations of the Right to Know Law should be reported to the nearest office of the Department of Labor and Industries.

PUBLIC PRESENTATIONS

Presentations and educational programs on occupational health or the Right to Know Law can be given for labor unions, trade associations and other groups.

OCCUPATIONAL HEALTH AND SAFETY SERVICES

Upon recept of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

The Division of Occupational Hygiene has the names of various occupational health services and occupational physicians who are board-certified. This information is available upon request.

MASSACHUSETTS DEPARTMENT OF LABOR AND INDUSTRIES

Division of Occupational Hygiene

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Division of Industrial Safety

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Worcester (617) 752-6504
Pittsfield (413) 445-4214

MASS.
MA13.2:
R245/2/
halo.

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

HALOTHANE

Synonyms: 1,1,1-trifluoro-2-chloro-2-bromoethane; narcotane; fluothane; halotan

CAS Number: 151-67-7

Chemical Formula: $C_2HBrClF_3$

Date Completed: 8/88

HAZARD SUMMARY

- Halothane causes adverse health effects when it is inhaled.
- Short-term exposure can cause dizziness, lightheadedness and confusion. At higher levels, it can cause shivering, nausea, vomiting, stupor and unconsciousness.
- Long-term exposure can cause damage to the liver with fever, aching, loss of appetite, nausea, and abdominal distress.
- Halothane is an anesthetic agent; as a group, these agents have been associated with excess cancers and miscarriages. It is not known if halothane itself causes cancer or miscarriages.

GENERAL DESCRIPTION

Halothane is a colorless, non-flammable, highly volatile liquid with a pleasant odor. Its only use is as a clinical anesthetic. It is estimated that halothane is used in two-thirds of all anesthesia applications.

HEALTH HAZARD INFORMATION

Exposure to halothane may occur by inhalation, ingestion, skin contact, and eye contact.

ACUTE (short-term) HEALTH EFFECTS

Acute exposure to halothane can cause dizziness, lightheadedness, and confusion. At higher levels, it can cause shivering, nausea, vomiting, stupor and unconsciousness.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #15,838-6pp-50cps 2/21/89 APPROVED BY: Ric Murphy, State Purchasing Agent

CHRONIC (long-term) HEALTH EFFECTS

Exposure to halothane can cause damage to the liver, which may lead to loss of appetite, nausea, abdominal distress, and jaundice (yellowish skin color).

Cancer Hazard:

Halothane is used as an anesthetic agent for surgery. Anesthetic agents as a group are associated with excess cancers among hospital operating room personnel. However, information is not currently available as to whether halothane in particular can cause cancer.

Reproductive Hazard:

Human studies have shown an increase in miscarriages, stillbirths and birth defects in the offspring of women and men exposed to anesthetic agents. However, these studies do not discriminate between the different anesthetics used.

Pregnant rats exposed to halothane have had miscarriages; decreased size and skeletal abnormalities of the offspring; and other reproductive effects. One study has indicated behavioral changes in baby rats exposed to halothane before and after birth.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Alcohol consumption may increase any liver damage caused by halothane.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: No exposure limits have been set.

ACGIH: The recommended airborne exposure limit is 50 ppm, averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit, not to be exceeded in any 1-hour period, is 2 ppm.

MEDICAL MONITORING

Pre-employment and periodic medical histories and physical exams should be performed on employees who will be exposed to halothane frequently or at high levels. This should include liver function tests.

EMERGENCY INFORMATION

FIRST AID

Inhalation:

In case of inhalation, remove patient from the contaminated area to fresh air. Give artificial respiration if the patient is not breathing. Seek immediate medical attention.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 0
Reactivity: 0
Health: 1

Flash Point: NA
Extinguishing Media: dry chemical, CO_2 waterspray or foam
Flammable Limits: NA

Respiratory Protection:

Self-contained breathing apparatus with a full-facepiece, operated in pressure-demand or other positive-pressure mode.

Protective Equipment:

Impervious clothing and gloves must be worn to prevent contact with liquid halothane.

Special Precautions:

Although halothane is not flammable, it may decompose in a fire to generate toxic halogen compounds such as hydrogen fluoride, hydrogen chloride, or hydrogen bromide.

SPILL, LEAK, AND DISPOSAL PROCEDURES

Halothane should be taken up with vermiculite or a similar absorbent material, and placed in a suitable container. The area of the spill should be isolated until the vapors have dissipated.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to halothane should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

For protection against halothane, a supplied-air respirator or self-contained breathing apparatus should be used.

PROTECTIVE EQUIPMENT

Eye Protection: Splash-proof safety goggles must be worn to prevent contact with liquid halothane.

Clothing: Appropriate impervious clothing, including protective gloves, must be worn

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Halothane is stable at ordinary temperatures and pressures. Exposure to light may cause decomposition.

INCOMPATIBILITIES

May decompose when exposed to light; may attack metals such as aluminum, brass, or lead in the presence of moisture; may dissolve rubber or plastics.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition will produce toxic fluorine, chlorine, and bromine, and their compounds, as well as toxic oxides of carbon.

STORAGE

Halothane should be stored in a dark, cool location.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 122°F (50°C)
Melting Point: N/A
Vapor Pressure: 243 mmHg @ 68°F
Specific Gravity (water=1): 1.87

Molecular Weight: 197.39
Solubility in Water: 0.35%
Evaporation Rate: NA
Vapor Density: NA

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

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ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

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MASS.
MA13.2:
R245/21
hydro. chlor.

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

HYDROCHLORIC ACID

Synonyms: Muriatic Acid, Chlorohydric Acid, Hydrochloride, Hydrogen Chloride, Spirits of Salt

Chemical Formula: HCl

C.A.S. Number: 7647-01-0

Date Completed: 9/88

HAZARD SUMMARY

- Hydrochloric acid vapors can irritate the lungs and cause bronchitis. Higher exposure can cause a build-up of fluid in the lungs and lead to death.
- Repeated contact with dilute solutions may cause skin rash or irritation.
- Hydrochloric acid is corrosive, and contact can cause eye damage and possibly blindness. It may also cause severe skin burns.
- Exposure can irritate the mouth, nose and throat. Long-term exposure can cause erosion of the teeth.

GENERAL DESCRIPTION

Hydrochloric acid is used in the production of fertilizers, dyes, dyestuffs, and paint pigments; in electroplating, metal pickling, leather tanning and soap refining. It is also used in laboratories and the photographic, textile and rubber industries.

HEALTH HAZARD INFORMATION

Exposure to hydrochloric acid may occur by inhalation, ingestion, skin contact and eye contact.

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Breathing the vapor can irritate the mouth, nose and throat. High levels may irritate

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

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APPROVED BY: Ric Murphy, State Purchasing Agent

the lungs, causing coughing and/or shortness of breath. Higher levels can cause a build-up of fluid in the lungs which can lead to death.

Ingestion: Hydrochloric acid may cause burns or ulceration of the mouth, throat, esophagus and stomach. Symptoms include pain, nausea, vomiting, salivation and thirst. Ingestion of even larger amounts may cause shock (symptoms: chills, cold, pale, bluish skin; sweating; rapid pulse and low blood pressure).

Skin Contact: Hydrochloric acid may cause extremely painful skin burns.

Eye Contact: Eye contact may cause pain, tearing, redness or blurred vision. Permanent eye injury may result if the acid is not immediately washed out with large amounts of water.

CHRONIC (long-term) HEALTH EFFECTS

Inhalation: Breathing hydrochloric acid may cause tooth erosion. Chronic inhalation may also cause chronic cough.

Skin Exposure: Exposure to vapors or dilute solutions may cause dermatitis.

Cancer Hazard: Not listed as a carcinogen by the International Agency for the Research of Cancer (IARC), the National Toxicology Program (NTP) or the Environmental Protection Agency's Carcinogen Assessment Group.

Reproductive Hazard: In a limited number of studies hydrochloric acid has been shown to cause mutations in living cells. There is inadequate information to determine any other reproductive effects of this chemical.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Not Available.

MEDICAL MONITORING

Medical monitoring for workers exposed to one half (or more) of the recommended exposure limit is advisable. The medical monitoring should include an annual medical and occupational history, physical examination and lung function tests. A chest x-ray may be advisable after an acute overexposure to hydrochloric acid.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by ACGIH. Other recommendations by NIOSH may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit, not to be exceeded at any time, is 5 ppm.

ACGIH: The recommended airborne exposure limit, not to be exceeded at any time, is 5 ppm.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Remove victim to fresh air immediately. Perform artificial respiration if breathing has stopped. Get medical attention immediately. Medical observation is recommended for 24-48 hours after exposure, since pneumonia may be delayed.

Ingestion: Do not induce vomiting. Drink large amounts of water or milk. If vomiting occurs, continue drinking of water or milk. Get medical attention immediately.

Skin: Immediately remove contaminated clothing. Flush the affected area with water for at least 15 to 20 minutes. Cover area of chemical burns with sterile, dry dressing and get medical attention immediately.

Eyes: Flush eyes with large amounts of water for at least 15 to 20 minutes, occasionally lifting upper and lower lids.

FIRE AND EXPLOSION

NFPA Rating
Flammability: 0
Reactivity: 0
Health: 3

Flash Point: Not flammable under normal temperature and pressure
Extinguishing Media: Dry chemical, carbon dioxide, water spray and foam
Flammable Limits: N.A.

Respiratory Protection:

Firefighting - Fullface self-contained breathing apparatus in positive-pressure mode.

Escape - Any acid gas mask
- Any escape self-contained breathing apparatus

Protective Equipment: Supplied-air, acid-resistant suits may be necessary under some circumstances.

SPILL, LEAK AND DISPOSAL PROCEDURES

Small Spills: Remove unnecessary personnel from the area. Personnel performing cleanup should use appropriate protective equipment (see PROTECTIVE MEASURES). Absorb spill with sand or other absorbent material. Neutralize the spill with sodium bicarbonate, lime or crushed limestone.

Large Spills: Contain the spill. Isolate the hazard area. Follow procedures for a small spill.

Disposal: Contact the Massachusetts Department of Environmental Quality Engineering for proper disposal procedures.

EMERGENCY INFORMATION

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are better than personal protective equipment. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Improper use of respirators can be dangerous. Only respirators that have been approved by NIOSH or MSHA for exposures to hydrochloric acid should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation.

The following guide should be consulted when selecting respirators:

Hydrochloric Acid Air Concentration	Minimum Respiratory Protection
50 ppm or less	- Any chemical cartridge respirator with acid gas cartridges, or - Any supplied-air respirator, or - Any self-contained breathing apparatus (SCBA)
100 ppm or less	- Full facepiece chemical cartridge respirator with acid gas cartridges, or - A gas mask with acid gas canister, or - Any full facepiece, helmet or hood supplied-air respirator - Any full facepiece SCBA
Greater than 100 ppm or entry into unknown concentrations	- Full facepiece SCBA operated in a positive-pressure mode, or - A combination of Type C full facepiece supplied-air respirator operating in positive-pressure mode and an auxiliary SCBA (as described above)

PROTECTIVE EQUIPMENT

Eye Protection: Splash-proof goggles and/or face shields should be worn when there is a possibility of eye or face contact with hydrochloric acid. An eye-wash fountain should be provided in the immediate work area.

Clothing: Protective clothing (e.g., aprons) should be used when there is a possibility of skin contact with hydrochloric acid. Natural rubber and some synthetic rubbers are resistant to hydrochloric acid. An emergency shower should also be provided in the immediate work area.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Stable under normal temperature and pressure.

INCOMPATIBILITIES

Metals, strong bases, alcoholic hydrogen cyanide, tetraselenium tetranitride, potassium permanganate, sulfuric acid, perchloric acid, acetic anhydride, 2-aminoethanol, chlorosulfonic acid, ethylenediamine, ethylene imine, oleum, beta-propiolactone, propylene oxide, vinyl acetate, mercury sulfate, formaldehyde (forms toxic dichlordimethyl ether), 1,1 difluoroethylene, Dowicil 100 (decomposition), sulphides.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition may release corrosive hydrogen chloride gas.

STORAGE

Store away from alkali or active metals (e.g., potassium, sodium, zinc) in a cool, well-ventilated area.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 384°F (196°C)
Melting Point: N.A.
Vapor Pressure: N.A.
Specific Gravity (water=1): 1.2

Molecular Weight: 36.46
Solubility in Water: Soluble
Evaporation Rate: N.A.
Vapor Density: 1.3

DEFINITIONS

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PUBLIC PRESENTATIONS

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MEDICAL EVALUATION

The Division of Occupational Hygiene has the names of various occupational health services and occupational physicians who are board-certified. This information is available upon request.

MASSACHUSETTS DEPARTMENT OF LABOR AND INDUSTRIES

Division of Occupational Hygiene

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Division of Industrial Safety

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MASS.
MA13.2.
R245/2/
hydrog. sulf.

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

HYDROGEN SULFIDE

Synonyms: hydrosulfuric acid, sulfuretted hydrogen, stink damp, sewer gas, sour gas
CAS Number: 7783-06-4

Chemical Formula: H_2S
Date Completed: 2/89

HAZARD SUMMARY

- **Hydrogen sulfide is a mucous membrane irritant and can cause significant eye and respiratory tract irritation.**
- **Exposure to high concentrations can cause headache, dizziness, confusion, loss of consciousness and ultimately death, in minutes to hours.**
- **The odor of hydrogen sulfide cannot be depended on as a warning of exposure.**

GENERAL DESCRIPTION

Hydrogen sulfide is a colorless flammable gas with a distinctive rotten-egg odor. It is used in the synthesis of inorganic and organic sulfur compounds, as an analytical reagent, and in metallurgy.

HEALTH HAZARD INFORMATION

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Inhalation of high concentrations of hydrogen sulfide, greater than 500 ppm, rapidly causes loss of consciousness and death. Low concentrations, which have a characteristic rotten egg odor, can cause nose and throat irritation, runny nose, cough, and shortness of breath. Odor, however, is a poor warning sign, since prolonged or high level exposure can cause temporary loss of smell. Prolonged exposure may cause lung damage, with respiratory failure occurring several hours following initial exposure. Headache, confusion, weakness, and dizziness may occur following exposures to 250 ppm over 1 to 2 hours.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #15813-6pgs-50cps-2/9/89 APPROVED BY: Ric Murphy, State Purchasing Agent

Skin Contact: High concentrations may cause severe irritation of the skin. Direct contact with the liquified gas may cause redness, pain and frostbite.

Eye Contact: Exposure to hydrogen sulfide at levels as low as 50 ppm has caused inflammation, pain, and tearing. Exposure to higher concentrations may result in "gas eyes", which is characterized by severe irritation, tearing and intense pain.

CHRONIC (long-term) HEALTH EFFECTS

Inhalation: The evidence of long-term effects from hydrogen sulfide exposure, such as fatigue, headache, dizziness, hoarseness, and cough, is controversial.

Eye Contact: Chronic exposure to hydrogen sulfide can cause inflammation of the eyes.

Cancer Hazard: Information is not available to determine a cancer hazard.

Reproductive Hazard: Information is not available to determine reproductive hazards.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Hydrogen sulfide may worsen symptoms of people who have pre-existing eye problems or impaired lung function.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations, made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 10 ppm, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 15 ppm.

ACGIH: The recommended airborne exposure limit is 10 ppm, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 15 ppm.

NIOSH: The recommended airborne exposure limit is 10 ppm, not to be exceeded in any 10-minute period.

MEDICAL MONITORING

Pre-employment and periodic medical histories should be provided. Initial monitoring should include a complete medical and occupational history, physical examination, chest x-ray and pulmonary function test (PFT). Medical monitoring, including PFT's, should be repeated annually. Chest x-rays should be done when clinically indicated.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Remove from exposure area to fresh air immediately. If breathing has stopped, trained personnel should give cardiopulmonary resuscitation (CPR). Administer oxygen if available. Get medical attention immediately.

Skin: In case of frostbite, warm the affected skin in warm water at a temperature of 107°F or wrap the affected area in blankets. Get medical attention immediately.

Eyes: Wash eyes immediately with large amounts of water (at least 15 to 20 minutes). In case of burns, apply sterile bandages loosely without medication. Get medical attention immediately.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 4	Flash Point: NA
Reactivity: 0	Extinguishing Media: CO_2, alcohol foam
Health: 3	Flammable Limits: lower - 4%; upper - 44%

Respiratory Protection: Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode.

Protective Equipment: Protective clothing, including cold-insulating gloves and splash-proof goggles with faceshield, should be used if contact with liquid hydrogen sulfide is a possibility. Suggested clothing materials are butyl rubber, neoprene, chlorinated polyethylene and styrene-butadiene rubber.

Special Precautions: No additional precautions.

SPILL, LEAK, AND DISPOSAL PROCEDURES

The leak should be stopped if it can be done without risk. Shut off ignition sources. Use water spray to reduce vapors. The water is corrosive and toxic, and should be diked for containment and neutralization with sodium bicarbonate or limestone. Isolate and evacuate the area of unnecessary personnel until the gas has dispersed. Ventilate closed spaces before entering.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are better than personal protective equipment. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation, and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Improper use of respirators can be dangerous. Only respirators that have been approved by NIOSH or MSHA for exposure to hydrogen sulfide should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation.

Recommended respiratory protection for hydrogen sulfide is given in the following table:

Gas Concentration	Minimum Respiratory Protection
300 ppm or less	Supplied-air respirator with a full facepiece or hood, or self-contained breathing apparatus with full facepiece.
Greater than 300 ppm	Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode.
Escape	Escape-type self-contained breathing apparatus, or gas mask that provides protection against acid gases or hydrogen sulfide.

PROTECTIVE EQUIPMENT

Eye Protection: Splash-proof safety goggles are to be worn if there is the possibility of contact with liquid hydrogen sulfide.

Clothing: Impervious clothing, gloves, and face shield are to be worn if there is the possibility of contact with liquid hydrogen sulfide. Suggested protective materials include butyl rubber, neoprene, chlorinated polyethylene and styrene-butadiene rubber.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Hydrogen sulfide is stable at normal temperatures and pressures.

INCOMPATIBILITIES

Reacts violently with oxidizing agents, metals, metal oxides, acetaldehyde and fluorine.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition may produce toxic and hazardous hydrogen, sulfur, and oxides of sulfur.

STORAGE

Protect against physical damage. Outside or detached storage is preferred. Inside storage should be in a cool, well-ventilated location with no combustion sources or oxidizing or corrosive materials. Protect against static electricity and direct sunlight.

PHYSICAL AND CHEMICAL DATA

Boiling Point: -76°F (-60°C)	Molecular Weight: 34.08
Melting Point: -121°F (-85°C)	Solubility in Water: soluble
Vapor Pressure: 17 atm. at 68°F	Evaporation Rate: NA
Specific Gravity (water=1): 1.19	Vapor Density: 1.2

ADDITIONAL INFORMATION

Hydrogen sulfide is generated as a by-product of many industrial processes, such as sewage treatment, oil and gas well drilling, and the manufacture of dyes, pigments, fertilizer, and synthetic petroleum products. It is also found in natural gas, volcanic gas, and some natural spring waters.

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

The following information is available from the Massachusetts Department of Labor and Industries.

RIGHT TO KNOW INFORMATION

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MASS.
MA13.2:
R245/21
Kero.

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

KEROSENE

Synonyms: Fuel oil #1, coal oil, range oil, paraffin oil
CAS Number: 8008-20-6

Chemical Formula: A mixture, having no fixed formula, of paraffinic, olefinic, naphthenic and aromatic hydrocarbons
Date Completed: 12/88

HAZARD SUMMARY

- **Kerosene can affect you when inhaled or swallowed, and by passing through your skin.**
- **Contact can irritate the skin. Prolonged contact may cause burns.**
- **Exposure can irritate the nose and throat. High exposures can cause lightheadedness, drowsiness and even coma.**
- **Breathing kerosene fumes may irritate the lungs, causing coughing and/or shortness of breath.**

GENERAL DESCRIPTION

Kerosene is a colorless-to-pale-yellow, clear mobile liquid. It is oily with a characteristic petroleum odor.

HEALTH HAZARD INFORMATION

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Vapours, mist or aerosol can cause irritation of the nose, throat and chest. Headache, dizziness and lightheadedness, resembling alcohol intoxication, may occur at low exposures. Confusion, disorientation and drowsiness ultimately leading to coma, may occur after higher exposures.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #15,836-7pgs-50cps 2/21/89
APPROVED BY: Ric Murphy, State Purchasing Agent

Skin Contact: May cause drying and irritation of the skin. Repeated and prolonged contact can result in skin blisters.

Eye Contact: Exposure to fumes, vapors or mists may cause irritation.

Ingestion: May lead to a burning sensation in the mouth, throat and stomach with nausea, vomiting and diarrhea. Ingestion of large quantities may result in kidney failure. If the liquid is drawn into the lungs, severe lung damage and death may occur. Drowsiness, lightheadedness, and coma, as mentioned above, may occur.

CHRONIC (long-term) HEALTH EFFECTS

Skin: Repeated exposure may lead to dermatitis.

Inhalation: Very irritating substances may affect the lungs. It is not known whether prolonged inhalation of kerosene causes lung damage.

Cancer Hazard: Insufficient data exist to determine whether kerosene is a cancer-causing agent.

Reproductive Hazard: In a limited number of studies, kerosene has been shown to cause mutations in living cells. Information is not available to determine any other reproductive effects from kerosene.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Not available.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

Kerosene as Petroleum Distillate:

OSHA: The legal airborne exposure limit is 1600 mg/m^3, averaged over an 8-hour workshift.

ACGIH: The recommended airborne exposure limit is 1600 mg/m^3, averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit is 350 mg/m^3, averaged over a 10-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 1800 mg/m^3.

Kerosene as Oil Mist (mineral):

OSHA: The legal airborne exposure limit is 5 mg/m^3, averaged over an 8-hour workshift.

ACGIH: The recommended airborne exposure limit is 5 mg/m^3, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 10 mg/m^3.

MEDICAL MONITORING

No specific medical monitoring is required.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Remove the individual from exposure area to fresh air immediately. If breathing has ceased, properly trained personnel should begin artificial respiration or cardiopulmonary resucitation (CPR) immediately. Obtain medical attention immediately.

Skin Contact: Remove contaminated clothing and shoes immediately. Wash affected areas with soap or mild detergent and large amounts of water until no evidence of chemical remains (15-20 minutes). Get medical help immediately.

Eye Contact: Flood eyes immediately with large amounts of water, giving particular attention to flooding under both upper and lower lids until no chemical remains (15-20 minutes). Get medical help immediately.

Ingestion: Extreme care must be taken to prevent aspiration. Never give anything by mouth if the victim is unconscious or losing consciousness. DO NOT INDUCE VOMITING. If vomiting occurs, have victim lean forward to reduce risk of aspiration. Obtain medical help immediately.

FIRE AND EXPLOSION

NFPA Rating:

Flammability: 2
Reactivity: 0
Health: 0

Flash Point: over 37.8°C (100°F)
Extinguishing Media: dry chemical, carbon dioxide, water spray or foam
Flammable Limits: lower - .7%; upper - 5%

Respiratory Protection: Self-contained breathing apparatus with full facepiece mask, operated in a pressure-demand or other positive-pressure mode.

Protective Equipment: Protective clothing and gloves impervious to kerosene to prevent repeated or prolonged skin contact; splash-proof safety goggles.

Special Precautions: Move containers from fire area if possible or cool exposed containers with water. Extinguish fire only if flow can be stopped. If the leak has not ignited, use water spray to disperse vapors and to protect personnel trying to stop a leak. Use water to flush spills away from sources of ignition, but prevent from flushing into public sewers.

SPILL, LEAK AND DISPOSAL PROCEDURES

Shut off ignition sources; keep unnecessary people away.

Respirator Protection: Self-contained breathing apparatus with a full facepiece operated in a pressure-demand or positive-pressure mode; or

Supplied-air respirator with a full facepiece operated in a pressure-demand or positive-pressure mode in combination with an auxilliary self-contained breathing apparatus operated in a positive-pressure or pressure-demand mode.

Protective Equipment: Wear appropriate protective clothing and gloves (made of neoprene, nitrile or PVA) to prevent repeated or prolonged skin contact; splash-proof safety goggles (do not wear contact lenses).

Small Spills: Take up with sand or other absorbent material and place in containers for later disposal.

Large Spills: Dike far ahead of spill for later disposal.

Disposal: Dispose according to local, state and federal regulations. Release to navegable waters must be reported to the National Response Center, tel. 1-800-424-8802.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are better than personal protective equipment. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to kerosene should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. The following respirators and maximum concentrations are recommended. Improper use of respirators can be dangerous.

Respiratory Protection for Kerosene Fumes

Vapor Concentration	Recommended Respiratory Protection
850 ppm	Self-contained breathing apparatus or any supplied-air respirator
2125 ppm	Supplied-air respirator operating in continuous-flow mode
4250 ppm	Self-contained breathing apparatus with full facepiece; or Any supplied-air respirator with full facepiece; or Any supplied-air respirator with a tight fitting facepiece operating in a continuous flow mode
10,000 ppm	Any supplied-air respirator with a 1/2 mask and operated in a positive-pressure mode or pressure-demand mode
Emergency or planned entry into unknown concentrations	See SPILL, LEAK AND DISPOSAL PROCEDURES
Escape	Any air-purifying full facepiece gas mask with chin style back- or front-mount organic vapor cannister; or Any appropriate escape type self-contained breathing apparatus

PROTECTIVE EQUIPMENT

Eye Protection: See SPILL, LEAK AND DISPOSAL PROCEDURES

Clothing: See SPILL, LEAK AND DISPOSAL PROCEDURES

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Kerosene is stable, but contact with strong oxidizers should be avoided.

INCOMPATIBILITIES

Avoid contact with nitrogen tetroxide, chlorine, fluorine, magnesium perchlorate.

HAZARDOUS DECOMPOSITION PRODUCTS

Hydrocarbons and their derivatives, carbon dioxide, carbon monoxide, sulfur dioxide.

STORAGE

Store in tightly closed containers in cool, dry, isolated and well-ventilated area away from heat, sources of ignition and incompatibles. Use non-sparking tools. Use ground lines and equipment during transfer to reduce the possibility of a fire or explosion from static sparks.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 151°-301°C (304°-574°F)
Melting Point: -18°C (0°F)
Vapor Pressure: 5 mmHg at 38°C
Specific Gravity (water=1): .8
Molecular Weight: varies
Solubility in Water: insoluble
Evaporation Rate: NA
Vapor Density: 4.5

ADDITIONAL INFORMATION

Kerosene is used as a fuel for lamps, stoves, trucks, aircraft and boilers. It is also used as a solvent for pesticides and as a degreaser for metals.

DEFINITIONS

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Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

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NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

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MASS. MA13.2: R245/2/lead/990

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

GOVERNMENT DOCUMENTS COLLECTION
SEP 20 1990
University of Massachusetts Depository Copy

LEAD

(lead paint removal)

Synonyms: White lead; lead flake; plumbum
Chemical Formula: Pb
Date Completed: 4/90
C.A.S. Number: 7439-92-1

HAZARD SUMMARY

- Inorganic lead can cause adverse health effects when inhaled or ingested.
- Ingestion may occur when eating, drinking or smoking with contaminated hands.
- Contaminated workclothes which are brought home can poison household members, particularly children.
- Lead can cause mood changes, headache, fatigue, muscle pain, weakness, abdominal cramping, and anemia.
- Permanent kidney, brain and other nerve damage may result from lead exposure.
- Exposure to lead can cause decreased fertility in men and women.
- Lead can damage the fetus.

GENERAL DESCRIPTION

Pure lead is a heavy, but soft and workable metal. It may be bluish-white or silver-grey. It is used in a wide variety of products, including storage batteries, ceramics, glass, plastics and paints.

HEALTH HAZARD INFORMATION

Exposure to inorganic lead can occur by inhalation of dust and fumes or ingestion of lead dust. Ingestion can occur due to eating, drinking or smoking with contaminated hands. Contaminated workclothes are a source of lead toxicity in household members (particularly children).

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #16,320-7 pgs.-100 cps-5/7/90 APPROVED BY: Ric Murphy, State Purchasing Agent

ACUTE (short-term) HEALTH EFFECTS

The early effects of lead toxicity are rather non-specific, with symptoms of irritability, depression, fatigue, decreased concentration, headache, loss of appetite, sleep disturbances, weakness, and musculo-skeletal pain.

The hallmark of acute lead toxicity is colic (severe stomach cramps). This may be accompanied by constipation or diarrhea.

CHRONIC (long-term) HEALTH EFFECTS

Prolonged or repeated exposure, even to low levels of lead, may result in an accumulation of lead in the body and may cause long-term health effects. Chronic exposure to lead can result in the acute health effects described above, although lead colic is generally less pronounced.

Although some effects of lead toxicity are reversible, chronic exposure can result in permanent damage to the nerves of the hands and feet, brain damage, gout, kidney failure, and possibly, high blood pressure. A rare manifestation of chronic lead exposure is a "lead line" which is a pigmented line on the gums.

Cancer Hazard: At present, there is inadequate evidence to state that lead is carcinogenic in humans. Some compounds of lead (lead acetate, lead subacetate, and lead phosphate) have been shown to be carcinogenic in rats and/or mice. These compounds should therefore be treated as carcinogens in humans.

Reproductive Hazard: Lead has been associated with a decrease in the fertility of men by causing decreased number and decreased motility of sperm and malformed sperm. These effects have been reported at blood levels of 40 to 50 mcg/dl. Lead can also cause impotence. High lead exposure in women has been associated with miscarriages, premature births, stillbirths and decreased fertility. Lead exposure of the pregnant mother at low blood levels (at about 10 to 15 mcg/dl and possibly lower) has been shown to interfere with normal brain development in the offspring. These levels are common in lead exposed workers. It is not known at this time whether lead causes other birth defects in humans. Lead, although not highly concentrated in breast milk, can be transferred to babies by that medium. Lead exposure in children can damage their nervous systems at levels lower than those that affect adults.

OCCUPATIONAL EXPOSURE LIMITS

The Massachusetts Deleading Regulations (454 CMR 22.00) regulate exposure to lead by requiring specific kinds of respirators for particular deleading methods. For sanding, scraping or use of a heat gun, the minimum required respirator is either a powered, air-purifying respirator with a high-efficiency (HEPA) filter, or a half-mask supplied-air respirator operated in the positive-pressure mode. When performing replacement or using caustics, the minimum required protection is a half-mask, air-purifying respirator with HEPA filters.

MEDICAL MONITORING

The Massachusetts Deleading Regulations require medical evaluation and testing for deleading workers. The medical evaluation must be performed prior to any deleading work. The medical evaluation must include: 1) a detailed work and medical history, with particular attention to past lead exposure, personal habits and past gastrointestinal, hematologic, renal, cardiovascular, reproductive and neurological problems; 2) a physical examination with particular attention to teeth, gums, hematologic, gastrointestinal, renal, cardiovascular, pulmonary and neurological systems; if a respirator is to be used, then fitness to wear a respirator should be assessed; 3) a blood pressure measurement; 4) blood tests for lead level, hemoglobin and hematocrit determinations, red cell indices, examination of peripheral smear morphology, zinc protoporphyrin, blood urea nitrogen (BUN), serum creatinine; 5) routine urinalysis with microscopic examination; and 6) any other test that the doctor considers necessary.

Blood testing must be conducted according to the following schedule: 1) for the first 6 months, every 2 months; and then at least every 3 months thereafter; 2) at least every two months if the lead level is between 40 mcg/100 g and 60 mcg/100 g of blood until 2 consecutive tests are below 40 mcg/100 g; 3) at least monthly while an employee is removed from work due to a high blood lead level (see below). The blood tests must include analysis of both lead and zinc protoporphyrin.

The deleading regulations require removal from exposure of a worker who has either: a confirmed blood lead level of 60 mcg/100 g or higher; or an average between 50 mcg/100 g and 59 mcg/100 g on three consecutive tests or over six months. Once removed, a worker may not return to a job with lead exposure until the blood lead is 40 mcg/100 g or less on two consecutive tests.

EMERGENCY INFORMATION

FIRST AID

Eye Contact: In case of eye contact, remove from exposure immediately. Rinse eyes for at least fifteen minutes, occasionally lifting upper and lower lids. See a physician if irritation persists or if vision is impaired.

Skin Contact: In case of skin contact, remove from exposure immediately. Remove contaminated clothing and wash skin with soap and water.

Treatment: Specific treatment is available for lead poisoning and must be administered by qualified medical personnel. Medicine, called "chelating agents," work by binding to and increasing the elimination of lead through the kidneys. These agents must not be given to workers currently working with lead (with the hope of preventing lead poisoning). Calcium disodium EDTA is the most common medicine used; British Anti-Lewisite (BAL), dimercaprol, and penicillamine can also be used.

FIRE AND EXPLOSION

NFPA Rating: Not Available

Flash Point: Not Available
Extinguishing Media: Dry chemical, carbon dioxide
Flammable Limits: Not Available

Fire and Explosion Hazards: Lead and lead dust present a negligible fire hazard.

Fire Fighting Procedures: Do not use water. Employees who are expected to fight fires must be trained and equipped according to 29 CFR 1926.150.

SPILL, LEAK AND DISPOSAL PROCEDURES

Respiratory Protection: See "Protective Measures - Respiratory Protection"

Protective Equipment: Under the Massachusetts Deleading Regulations, employers are required to provide protective clothing to their employees. This clothing must include full-body coveralls, gloves, head covering, shoes or shoe coverings, and protective eyewear.

Clean-up Procedures: Clean-up of lead dust must be done using a vacuum equipped with a high-efficiency particulate air (HEPA) filter; dry sweeping is never acceptable. Surfaces should first be vacuumed, then washed with a solution of trisodium phosphate, then vacuumed again.

Disposal: Lead-contaminated waste must be placed in double plastic bags a minimum of 6 mils thick and then sealed before being removed from the work area. The waste must then be disposed of in accordance with federal, state and local regulations. A sample of the waste may have to be analyzed to determine the proper disposal method. The Massachusetts Department of Environmental Protection may provide additional information.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to lead may be used. The employer should have a written program that includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

Method of Deleading/Conditions of Use	Required Respirators[1]
caustics; replacement	Half-mask, air-purifying respirator equipped with high-effiency filters[2,3]
scraping; sanding; heat gun	Powered, air-purifying respirator with high-efficiency filters[3]; or Half-mask supplied-air respirator operated in positive-pressure mode.[2]
Firefighting	Full facepiece, self-contained breathing apparatus, operated in positive-pressure mode.

1. Respirators specified for higher concentrations can be used at lower concentrations of lead.
2. If eye irritation develops, full facepiece respirators should be used.
3. A high-efficiency particulate filter removes 99.97% of all particles at least 0.3 microns in diameter.

PROTECTIVE EQUIPMENT

Protective clothing should be worn - and disposed of by the employer - whenever the possibility exists for employee exposure to lead dust or fume. These particles may be brought home on workers' clothing, if uncovered, and cause health problems for the workers' families. Work clothing should be HEPA-vacuumed before removal. See "Emergency Information - Spill, Leak and Disposal Procedures".

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Stable under normal temperature and pressure.

INCOMPATIBILITIES

Avoid contact with oxidizing agents, such as perchlorates, peroxides, permanganates, chlorates and nitrates; chemically active metals, such as potassium, sodium and magnesium.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition products are oxides of lead.

STORAGE

Lead should be stored away from high heat.

Lead, including waste materials, should always be stored in properly labelled containers. Labels should warn of the serious health hazards associated with exposure.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 1740°C (3164°F)
Melting Point: 328°C (622°F)
Vapor Pressure: 1.77 mmHg at 1000°C
Specific Gravity (water=1): 11.3
Molecular Weight: 207
Solubility in Water: Insoluble
Evaporation Rate: Not Applicable
Vapor Density: Not Available

ADDITIONAL INFORMATION

Deleading in a residence or child care center may only be performed by licensed contractors and trained workers according to the Massachusetts Deleading Regulations: 454 CMR 22.00, and the Lead Poisoning Prevention and Control Regulations: 105 CMR 460.000. These regulations should be consulted for specific required work practices.

Workers with high blood lead levels require consultation with a physician. They should be immediately removed from exposure to lead. Occasionally, medical treatment may be required to lower blood lead levels, but this should only be performed in a hospital under the supervision of an occupational medicine physician.

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

The following information is available from the Massachusetts Department of Labor and Industries.

RIGHT TO KNOW INFORMATION

The Right to Know Program can answer questions about particular chemicals, training, labeling, and other Right to Know matters. Violations of the Right to Know Law should be reported to the nearest office of the Department of Labor and Industries.

PUBLIC PRESENTATIONS

Presentations and educational programs on occupational health or the Right to Know Law can be given for labor unions, trade associations and other groups.

OCCUPATIONAL HEALTH AND SAFETY SERVICES

Upon recept of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

The Division of Occupational Hygiene has the names of various occupational health services and occupational physicians who are board-certified. This information is available upon request.

MASSACHUSETTS DEPARTMENT OF LABOR AND INDUSTRIES

Division of Occupational Hygiene

West Newton (617) 969-7177

Division of Industrial Safety

Boston (617) 727-3460
Lawrence (617) 681-7798
New Bedford (617) 997-8263
Springfield (413) 734-1421
Worcester (617) 752-6504
Pittsfield (413) 445-4214

MASS. MA S 13.2: R245/2/lead

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

LEAD

(inorganic)

Synonyms: White lead; lead flake; plumbum

Chemical Formula: Pb

Date Completed: 7/88

C.A.S. Number: 7439-92-1

HAZARD SUMMARY

- Inorganic lead can cause adverse health effects when inhaled or ingested.
- Ingestion may occur when eating, drinking or smoking with contaminated hands.
- Contaminated workclothes which are brought home can poison household members, particularly children.
- Lead can cause mood changes, headache, fatigue, muscle pain, weakness, abdominal cramping, and anemia.
- Permanent kidney, brain and other nerve damage may result from lead exposure.
- Exposure to lead can cause decreased fertility in men and women.
- Lead can damage the fetus.

GENERAL DESCRIPTION

Pure lead is a heavy, but soft and workable metal. It may be bluish-white or silver-grey. It is used in a wide variety of products, including storage batteries, ceramics, glass, plastics and paints.

HEALTH HAZARD INFORMATION

Exposure to inorganic lead can occur by inhalation of dust and fumes or ingestion of lead dust. Ingestion can occur due to eating, drinking or smoking with contaminated hands. Contaminated workclothes are a source of lead toxicity in household members (particularly children).

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p2. Chronic Health Effects
p3. Emergency Information
p4. Protective Measures
p5. Storage and Reactivity Information
p5. Physical and Chemical Data
p7. Definitions

Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #15.835-7pp-50cps 2/21/89 APPROVED BY: Ric Murphy, State Purchasing Agent

ACUTE (short-term) HEALTH EFFECTS

The early effects of lead toxicity are rather non-specific, with symptoms of irritability, depression, fatigue, decreased concentration, headache, loss of appetite, sleep disturbances, weakness, and musculo-skeletal pain.

The hallmark of acute lead toxicity is colic (severe stomach cramps). This may be accompanied by constipation or diarrhea.

CHRONIC (long-term) HEALTH EFFECTS

Prolonged or repeated exposure, even to low levels of lead, may result in an accumulation of lead in the body and may cause long-term health effects. Chronic exposure to lead can result in the acute health effects described above, although lead colic is generally less pronounced.

Although some effects of lead toxicity are reversible, chronic exposure can result in permanent damage to the nerves of the hands and feet, brain damage, gout, kidney failure, and possibly, high blood pressure. A rare manifestation of chronic lead exposure is a "lead line" which is a pigmented line on the gums.

Cancer Hazard: At present, there is inadequate evidence to state that lead is carcinogenic in humans. Some compounds of lead (lead acetate, lead subacetate, and lead phosphate) have been shown to be carcinogenic in rats and/or mice. These compounds should therefore be treated as carcinogens in humans.

Reproductive Hazard: Lead has been associated with a decrease in the fertility of men by causing decreased number and decreased motility of sperm and malformed sperm. These effects have been reported at blood levels of 40 to 50 mcg dl. Lead can also cause impotence. High lead exposure in women has been associated with miscarriages, premature births, stillbirths and decreased fertility. Lead exposure of the pregnant mother at low blood levels (at about 10 to 15 mcg/dl and possibly lower) has been shown to interfere with normal brain development in the offspring. These levels are common in lead exposed workers. It is not known at this time whether lead causes other birth defects in humans. Lead, although not highly concentrated in breast milk, can be transferred to babies by that medium. Lead exposure in children can damage their nervous systems at levels lower than those that affect adults.

OCCUPATIONAL EXPOSURE LIMITS

OSHA regulates exposure on the basis of both the levels of lead dust and fume in the air and the amount of lead in a worker's blood. OSHA requires employers to remove any worker with excessive blood lead levels from their workplace exposures without the loss of pay, seniority or benefits. The decision to test blood is based on the airborne lead level and/or on the results of previous blood tests.

The OSHA Permissible Exposure Limit (PEL) is 0.05 milligrams per cubic meter (mg/m^3) averaged over an 8-hour day (TWA). In addition, the OSHA Standard has specific requirements for air monitoring, medical surveillance, engineering controls and respiratory protection. The number of the standard is 29 CFR 1910.1025 and should be used as a reference for specific details when lead is used in the workplace.

MEDICAL MONITORING

Federal law (29 CFR 1910.1025) requires medical evaluation and testing for workers exposed to lead above the action level (30 mcg/m^3) for over 30 days per year. The medical evaluation must be performed prior to work in areas with lead levels above the action level and under certain other conditions (see 29 CFR 1910.1025 for more details). The medical evaluation must include: 1) a detailed work and medical history, with particular attention to past lead exposure, personal habits and past gastrointestinal, hematologic, renal, cardiovascular, reproductive and neurological problems; 2) a physical examination with particular attention to teeth, gums, hematologic, gastrointestinal, renal, cardiovascular and neurological systems; if a respirator is to be used, then fitness to wear a respirator should be assessed; 3) a blood pressure measurement; 4) blood tests for lead level, hemoglobin and hematocrit determinations, red cell indices, examination of peripheral smear morphology, zinc protoporphyrin, blood urea nitrogen (BUN), serum creatinine; 5) routine urinalysis with microscopic examination; and 6) any other test that the doctor considers necessary.

Blood testing must be conducted according to the following schedule: 1) at least every six months; 2) at least every two months if the lead level is between 40mcg/100g and 60mcg/100g of blood; 3) at least monthly while an employee is removed from work due to a high blood lead level (see below). The repeat blood tests must include analysis of both lead and zinc protoporphyrin.

OSHA requires removal from exposure of a worker who has either: a confirmed blood lead level of 60mcg/100g or higher; an average between 50mcg/100g and 59mcg/100g on three consecutive tests or over six months; or a medical condition for which a physician considers medical removal necessary. Once removed, a worker may not return to a job with lead exposure until the blood lead is 40mcg/100g or less on two consecutive tests, or the employee no longer has the medical condition that required removal.

EMERGENCY INFORMATION

FIRST AID

Eye Contact: In case of eye contact, remove from exposure immediately. Rinse eyes for at least fifteen minutes, occasionally lifting upper and lower lids. See a physician if irritation persists or if vision is impaired.

Skin Contact: In case of skin contact, remove from exposure immediately. Remove contaminated clothing and wash skin with soap and water.

Treatment: Specific treatment is available for lead poisoning and must be administered by qualified medical personnel. Medicine, called "chelating agents," work by binding to and increasing the elimination of lead through the kidneys. These agents must not be given to workers currently working with lead (with the hope of preventing lead poisoning). Ca EDTA is the most common medicine used; BAL, dimercaprol, and penicillamine can also be used.

FIRE AND EXPLOSION

NFPA Rating: Not Available

Flash Point: Not Available
Extinguishing Media: Dry chemical, carbon dioxide
Flammable Limits: Not Available

Fire and Explosion Hazards: Lead and lead dust present a negligible fire hazard.

Fire Fighting Procedures: Do not use water. Employees who are expected to fight fires must be trained and equipped according to OSHA 1910.156.

SPILL, LEAK AND DISPOSAL PROCEDURES

Respiratory Protection: See "Protective Measures - Respiratory Protection"

Protective Equipment: Under the OSHA Lead Standard, employers are required to provide protective clothing when the PEL is exceeded, even where respirators are used. This clothing may include full-body coveralls, gloves, head covering, shoes or shoe coverings, faceshields and goggles.

Clean-up Procedures: Clean-up of lead dust should be done using a vacuum equipped with a high-efficiency particulate air (HEPA) filter; dry sweeping is never acceptable. Wet methods should always be used, even when vacuuming. Clean-up should be performed only by trained personnel who are properly protected.

Disposal: Lead-contaminated wastes should be disposed of in accordance with the requirements of federal, state and local agencies. A sample of the waste may have to be analyzed to determine the proper disposal method. The regional offices of the Massachusetts Department of Environmental Quality Engineering (DEQE) may provide additional information.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to lead should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

Airborne Lead Concentration (Dust or Fume)	Required Respirators[1]
0.5 mg/m^3 or less (10 x PEL)	Half-mask, air-purifying respirator (negative pressure or powered) equipped with high-effiency filters[2,3]
2.5 mg/m^3 or less (50 x PEL)	Full facepiece, air-purifying respirator (negative pressure or powered) with high-efficiency filters[3]
50 mg/m^3 or less (1000 x PEL)	Half-mask supplied-air respirator operated in positive-pressure mode.[2]
100 mg/m^3 or less	Supplied-air respirator with full facepiece, hood, helmet or suit, operated in positive-pressure mode.
Greater than 100 mg/m^3; unknown concentration; firefighting	Full facepiece, self-contained breathing apparatus, operated in positive-pressure mode.

1. Respirators specified for higher concentrations can be used at lower concentrations of lead.
2. If eye irritation develops, full facepiece respirators should be used.
3. A high-efficiency particulate filter removes 99.97% of all particles at least 0.3 microns in diameter.

PROTECTIVE EQUIPMENT

Protective clothing should be worn - and disposed of by the employer - whenever the possibility exists for employee exposure to lead dust or fume. These particles may be brought home on workers' clothing, if uncovered, and cause health problems for the workers' families. Work clothing should be HEPA-vacuumed before removal. See "Emergency Information - Spill, Leak and Disposal Procedures".

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Stable under normal temperature and pressure.

INCOMPATIBILITIES

Avoid contact with oxidizing agents, such as perchlorates, peroxides, permanganates, chlorates and nitrates; chemically active metals, such as potassium, sodium, magnesium and zinc.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition products are oxides of lead.

STORAGE

Lead should be stored away from high heat.

Lead, including waste materials, should always be stored in properly labelled containers. Labels should warn of the serious health hazards associated with exposure. The OSHA Lead Standard has specific labelling requirements.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 1740°C (3164°F)	Molecular Weight: 207
Melting Point: 328°C (622°F)	Solubility in Water: Insoluble
Vapor Pressure: 1.77 mmHg at 1000°C	Evaporation Rate: Not Applicable
Specific Gravity (water=1): 11.3	Vapor Density: Not Available

ADDITIONAL INFORMATION

Inorganic lead and lead compounds are found in a wide variety of materials and industrial processes. Metallic lead is a major component of solder, type metal, battery plates, plumbing fixtures and linings for chemical tanks. It is a common constituent of bronzes and some steels. Compounds of lead are widely used in the manufacture of storage batteries, ceramics, glass, plastics and paints. Organic lead is added to gasoline as an anti-knock agent. Target practice may result in elevated lead exposures.

Workers with high blood lead levels require consultation with a physician. They should be immediately removed from exposure to lead. Occasionally, medical treatment may be required to lower blood lead levels, but this should only be performed in a hospital under the supervision of an occupational medicine physician.

For a copy of the OSHA Lead Standard 29 CFR 1910.1025, call the nearest OSHA office.

Waltham: (617) 647-8681
Springfield: (413) 785-0123

DEFINITIONS

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ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

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MEDICAL EVALUATION

The Division of Occupational Hygiene has the names of various occupational health services and occupational physicians who are board-certified. This information is available upon request.

MASSACHUSETTS DEPARTMENT OF LABOR AND INDUSTRIES

Division of Occupational Hygiene

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Division of Industrial Safety

Boston (617) 727-3460
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New Bedford (617) 997-8263
Springfield (413) 734-1421
Worcester (617) 752-6504
Pittsfield (413) 445-4214

MASS.
MA13.2:
R245/2/
Magnes

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

MAGNESIUM

Synonyms: Not Applicable
C.A.S. Number: 7439-95-4
Chemical Formula: Mg
Date Completed: 04-88

HAZARD SUMMARY

- **Magnesium can cause mucous membrane irritation and an upset stomach.**
- **Magnesium fumes can cause fever and difficulty breathing.**
- **Slow healing sores may result from skin contact with magnesium.**

GENERAL DESCRIPTION

Magnesium is a light, silvery-white metal. It is used in making structural parts, die-cast auto parts, missiles, precision instruments and optical mirros.

HEALTH HAZARD INFORMATION

Exposure to magnesium may occur by inhalation, ingestion, skin contact, and eye contact.

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Inhalation causes irritation of the throat and nasal mucosa, and cough. Inhalation of magnesium oxide fumes may cause metal fume fever with symptoms of cough, headache, fever, chills, sweating, nausea and vomiting, chest pain, shortness of breath and an elevated white blood count; these symptoms begin within several hours after exposure and last approximately 24 hours after exposure.

Ingestion: Ingestion can cause nausea, diarrhea, and abdominal pain.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #15,834-6pgs-50cps 2/21/89
APPROVED BY: Ric Murphy, State Purchasing Agent

Skin Contact: Magnesium in finely divided form is very flammable; when ignited, hot particles of magnesium can cause thermal burns. Fragments of magnesium embedded in the skin have been shown to cause slow healing sores in animals.

Eye Contact: Eye contact can cause eye irritation.

CHRONIC (long-term) HEALTH EFFECTS

There is no evidence of lung injury from inhalation. Incidence of digestive disorders in magnesium plant workers may be higher than normally expected.

Cancer Hazard: Data are currently not available to indicate whether or not magnesium is a cancer-causing agent.

Reproductive Hazard: No data on occupationally-related reproductive effects to magnesium are available.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

No data is available.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

No exposure limits have been set for magnesium. The following are limits set for magnesium oxide fume.

OSHA: The legal airborne exposure limit is 5 mg/m^3 (respirable dust), averaged over an 8-hour workshift.

ACGIH: The recommended airborne exposure limit is 10 mg/m^3, averaged over an 8-hour workshift.

MEDICAL MONITORING

There is no specific test for this chemical.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Move patient to fresh air. Start CPR if breathing has stopped. Keep patient warm and at rest. Seek immediate medical attention.

Ingestion: Seek immediate medical attention for supportive treatment.

Skin: Remove contaminated clothing and shoes. Wipe off contaminated skin immediately. Immediately rinse skin with running water for at least fifteen minutes. Seek immediate medical attention. If fragments of magnesium are imbedded in the skin, they should be removed by medical personnel.

Eyes: Immediately rinse eyes with running water for at least fifteen minutes, occasionally lifting upper and lower lids. Seek immediate medical attention.

FIRE AND EXPLOSION

NFPA Rating
- Flammability: 1
- Reactivity: 2
- Health: 0

Flash Point: Not available
Extinguishing Media: G-1 powder, powdered talc
Flammable Limits: Not available

Fire and Explosion Hazards: Magnesium is a combustible metal. Fine powder, thin sheets and chips are easily ignited. In finely-divided form magnesium will react with water and acid to release hydrogen.

Protective Equipment: Appropriate clothing and gloves should be worn to prevent prolonged or repeated skin contact. Splash-proof or dust-resistant goggles and face shield should be worn to prevent eye contact. The employer should provide an eye wash fountain in the immediate work area if there is any possibility of eye contamination.

Respiratory Protection: Self-contained breathing apparatus with full-facepiece operated in pressure-demand or other positive-pressure mode; or supplied-air respirator with full-facepiece, and operated in pressure-demand mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive mode.

Fire Fighting Procedures: Fire fighters may approach a fire within a few feet if no moisture is present. Foam, water and ordinary extinguishers should not be used.

SPILL, LEAK AND DISPOSAL PROCEDURES

Respiratory Protection: Self-contained breathing apparatus in positive-pressure mode.

Protective Equipment: Clothing and gloves impervious to magnesium; splash-proof or dust resistant goggles and a face shield.

Small Spills: Shut off ignition sources. Flares, smoking and flames are prohibited. Do not touch spilled material. Stop leak if it can be done without risk. Do not wet. Place material into clean, dry container with a clean shovel.

Large Spills: Follow precautionary measures of small spills. Dike spill for later disposal. Cover powder spills with plastic sheets or tarp to minimize spreading. Isolate area and deny entry.

Disposal: Place powdered magnesium in sealed containers. Dispose according to state, local and federal regulations.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to magnesium should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

PROTECTIVE EQUIPMENT

Eye Protection: See "Emergency Information" section.

Clothing: See "Emergency Information" section.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Contact with water releases highly flammable hydrogen gas. Magnesium powder forms an explosive mixture with air which may be ignited by a spark.

INCOMPATIBILITIES

Avoid contact with acids, alumìnum, carbonates, sulfates, cyanides, halogens, manganese, oxides, oxidizing agents, oxygen (liquid), trichloroethylene.

HAZARDOUS DECOMPOSITION PRODUCTS

None known.

STORAGE

Protect against physical damage. Store finely divided chips or shavings in detached fire-resistant building, protected from moisture and away from chlorine, bromine, iodine acids (e.g., hydrochloric, sulfuric, nitric) and chlorine trifluoride and all possible sources of ignition. Heavier sections may be stored in the open like steel or aluminum. Use only nonsparking tools and equipment when opening or closing containers of magnesium.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 1107°C (2025°F)
Melting Point: 649°C (1200°F)
Vapor Pressure: 1 mmHg at 621°C
Specific Gravity (water=1): 1.738
Molecular Weight: 24.31
Solubility in Water: Insoluble
Evaporation Rate: Not Applicable
Vapor Density: Not Applicable

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

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ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

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MASS.
MA13.2:
R245/2/
Mala.

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

MALATHION

Synonyms: Carbofos
Mercaptothion
Cythion

Chemical Formula: $C_{10}H_{19}O_6PS_2$

Date Completed: 6/88

C.A.S. Number: 121-75-5

HAZARD SUMMARY

- **Malathion can cause poisoning when breathed in and when absorbed through skin.**
- **Exposure can cause organophosphate poisoning with symptoms of difficulty breathing, sweating, nausea and vomiting, diarrhea, headache, weakness, and death.**

GENERAL DESCRIPTION

Malathion may be in the form of a yellow to brown liquid with a garlic or skunk-like odor, or a powder.

HEALTH HAZARD INFORMATION

Exposure to malathion may occur by inhalation, ingestion, skin contact, and eye contact.

ACUTE (short-term) HEALTH EFFECTS

Exposure to low concentrations of malathion can cause flu-like symptoms of headache, muscle ache, and runny nose.

Moderate exposure can have the following effects: chest tightness, shortness of breath, coughing, wheezing, salivation, tearing of the eyes, blurred

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #15,833-5pgs-50cps 2/21/89
APPROVED BY: Ric Murphy, State Purchasing Agent

vision, runny nose, sweating, nausea, vomiting, abdominal cramps, diarrhea, constricted pupils, skin irritation, muscle twitching, muscle weakness, anxiety, and headache.

In severe cases, there can be tremors, confusion, drowsiness, slurred speech, coma, loss of reflexes, seizures, irregular heart beat and death.

Effects can occur any time within several hours. The time course may vary depending on the route of exposure

CHRONIC (long-term) HEALTH EFFECTS

A syndrome of nervous system damage with weakness, spasticity and paralysis, has been reported with exposures to other pesticides in the same class as malathion.

Cancer Hazard: Malathion is not likely to be a cancer-causing agent.

Reproductive Hazard: There is no evidence that malathion causes birth defects in animals. In a few studies, offspring of exposed animals have exhibited decreased survival and growth retardation. There is limited evidence that malathion may be a mutagen. There is no other data on the reproductive effects of malathion in humans.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Malathion potentiates other organo-phosphate insecticides (i.e., simultaneous exposure to malathion and other similar insecticides may result in more severe symptoms than expected).

MEDICAL MONITORING

Preplacement and periodic medical histories and physical examinations should be done by qualified personnel. Pre-employment erythrocyte and plasma cholinesterase levels should be obtained and should be rechecked periodically and after heavy malathion exposure. Workers should be removed from malathion exposure if their cholinesterase level decreases more than 25 percent from their pre-exposure level. A normal cholinesterase level does not mean that there is no overexposure.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 5 mg/m^3 (respirable dust), averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit is 15 mg/m^3, averaged over a 10-hour workshift.

ACGIH: The recommended airborne exposure limit is 10 mg/m^3, averaged over an 8-hour workshift.

EMERGENCY INFORMATION

FIRST AID

Immediate medical attention must be sought for exposure to malathion.

Inhalation: Move patient to fresh air. If patient is not breathing, begin artificial respiration immediately. Seek immediate medical attention.

Ingestion: If the patient is conscious, induce vomiting. Gastric lavage and saline catharsis should be done by trained medical personnel.

Skin Contact: Remove clothing promptly. Decontaminate skin with soap or detergent and large amounts of water (e.g., shower).

Eye Contact: Irrigate with large amounts of water for at least fifteen to twenty minutes, occasionally lifting lower and upper lids.

Antidotes: Specific treatment exists for malathion poisoning; it must be administered by trained medical personnel. Atropine should be administered immediately in suspected malathion poisoning. Poisoned patients have a very large tolerance for atropine; hence, very large doses must be used. Pralidoxime should be administered in conjunction with atropine. Erythrocyte and plasma cholinesterase levels should be obtained prior to administration of pralidoxime. Patients must be carefully observed for a relapse. Antidotes must not be given before exposure to malathion.

FIRE AND EXPLOSION

NFPA Rating: N/A
Flash Point: above 325°F (163°C)
Autoignition Temp.: N/A
Extinguishing Media: dry chemical, CO_2, water
Flammable Limits: N/A

Respiratory Protection: To enter an area of unknown concentration, wear a self-contained breathing apparatus with a full facepiece or a supplied-air pressure-demand respirator with an auxiliary self-contained breathing apparatus.

Protective Equipment: Wear chemical protective clothing specifically recommended by manufacturer, including full-body coverall, gloves and footwear.

Special Precautions: N/A

SPILL, LEAK AND DISPOSAL PROCEDURES

Small Spills: Take up any spilled malathion with absorbent material. Decontaminate equipment with 5% sodium hydroxide. (Wet spilled powder with 5% NaOH and absorb - or - vacuum, do not sweep, spilled material.)

Large Spills: Dike ahead of the spill for later disposal.

Disposal: Hydrolize with an alkaline solution with a pH of 12. Incinerate with a flammable solvent in a furnace with an afterburner and scrubber.

EMERGENCY INFORMATION

CHEMTREC: (800) 424-9300
POISON CONTROL: (800) 682-9211; 232-2120 (Boston area)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are better than personal protective equipment. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Improper use of respirators can be dangerous. Only respirators that have been approved by NIOSH or MSHA for exposures to malathion should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation.

PROTECTIVE EQUIPMENT

Eye Protection: Wear goggles to protect against repeated or prolonged eye contact.

Clothing: If skin exposure is likely, wear full body coveralls, impervious gloves and impervious footwear.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Malathion reacts with heavy metals.

INCOMPATIBILITIES

Malathion is decomposed by acids and bases and is incompatible with strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS

Toxic decomposition products from a fire include sulfur dioxide, phosphoric acid mist and carbon monoxide.

STORAGE

Malathion has a corrosive action on iron, steel, tin plate, lead and copper.

PHYSICAL AND CHEMICAL DATA

Boiling Point: N/A
Molecular Weight: 330.3
Melting Point: 37°F (2.85°C)
Vapor Density: N/A

Vapor Pressure: 0.00004 mmHg at 20°C
Evaporation Rate: N/A
Specific Gravity (water=1): 1.23 at 25°C
Solubility in Water: 0.0145 g/100g water at 20°C

DEFINITIONS

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Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

MANGANESE

Synonyms: N/A **Chemical Formula: Mn**
CAS Number: 7439-96-5 **Date Completed: 6/88**

HAZARD SUMMARY

- **Manganese can cause medical problems when inhaled.**
- **Manganese fumes can cause a flu-like illness.**
- **Long-term exposure to manganese can cause brain damage. In the late stages this illness resembles Parkinson's disease and is permanent.**
- **Manganese can cause liver damage.**

GENERAL DESCRIPTION

Manganese is a whitish-gray, brittle and reactive metal.

HEALTH HAZARD INFORMATION

Exposure to manganese may occur by inhalation of dust, fumes or mists and by ingestion. Inhalation is the main source of absorption of manganese into the body. However, because ingestion may occur due to contaminanted cigarettes, food or beverages, hands should be washed before eating or smoking.

ACUTE (short-term) HEALTH EFFECTS

Manganese dioxide fumes can cause "metal fume fever", a flu-like illness, with symptoms of thirst, dry cough, throat dryness, nausea, headache, chills, sweating, fatigue, chest discomfort, aching, and fever. These symptoms begin a few hours after exposure, and usually disappear within 24 hours.

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1001 Watertown Street, West Newton, MA 02165

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APPROVED BY: Ric Murphy, State Purchasing Agent

Alloys and compounds of manganese are minor irritants of the eye, skin and mucous membrane (the moist skin of the eyes, nose, mouth and throat).

CHRONIC (long-term) HEALTH EFFECTS

Long-term exposure to manganese can cause damage to the nervous system, lungs and liver.

Nervous system: The damage caused to the nervous system can be divided into three stages:

1. The earliest symptoms are vague, including muscle spasms, weakness, and joint pain.

2. In the second stage, there are speech disturbances, difficulty walking, and excessive salivation.

3. The third stage, which is not reversible, resembles Parkinson's disease. This may occur after at least six months of exposure. This stage is manifested by a "mask-like" facial expression, muscle weakness, muscle rigidity, tremors, and increased difficulty walking.

Lungs: Exposure to manganese may increase the likelihood of pneumonia.

Liver: Exposure to manganese may cause liver damage (cholestasis).

Cancer Hazard: Information is not currently available as to whether manganese may cause cancer.

Reproductive Hazard: Experimental female rodents given manganese compounds before and during pregnancy have had offspring with changes in growth, including retardation. The offspring have also been affected through the mother's milk. Exposure to manganese compounds has injured the reproductive system in male rodents.

In one study in humans, male workers exposed to manganese compounds had fewer children than those not exposed.

Manganese has been shown to cause mutations in living cells.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Some lung, liver, psychiatric, and nervous system disorders may be made worse by manganese exposure. Smokers who are exposed to manganese may be more likely to develop bronchitis than are smokers without manganese exposure.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations by NIOSH may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

Manganese Dust

OSHA: The legal airborne exposure limit, not to be exceeded at any time, is 5 mg/m^3.

ACGIH: The recommended airborne exposure limit is 5 mg/m^3, not to be exceeded at any time.

Manganese Fumes

OSHA: The legal airborne exposure limit is 1 mg/m^3, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 3 mg/m^3.

ACGIH: The recommended airborne exposure limit is 1 mg/m^3, averaged over an 8-hour workshift. The recommended short-term exposure limit, not to be exceeded in any 15-minute period, is 3 mg/m^3.

MEDICAL MONITORING

Pre-employment and periodic medical histories and physical exams should be obtained for workers exposed to manganese. Attention should be paid to lung, liver, psychiatric and nervous system disorders. Urine levels of manganese can be used to assess the amount of exposure to manganese in groups of workers, but in individual workers the levels are not very meaningful. The normal level of manganese in urine is less than 3 ug/L. At levels greater than 40 to 50 ug/L neurological symptoms may eventually occur.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Move the patient to fresh air. If breathing has stopped, begin artificial respiration. Seek immediate medical attention.

Ingestion: If the patient is conscious, he/she should first drink large amounts of water, and then be induced to vomit. Seek immediate medical attention.

Skin contact: Remove contaminated clothing, and wash skin with soap and water.

Eye Contact: Immediately rinse eyes with running water for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention if irritation persists.

Antidotes: There are several agents which can be used to lessen the symptoms of manganese toxicity. These must be administered by trained medical personnel. L-dopa and 5-hydroxytryptophan can be used to improve the Parkinson-like symptoms due to chronic manganese exposure. Calcium EDTA can be used to decrease the amount of manganese in the body.

FIRE AND EXPLOSION

NFPA Rating:

Flammability: 3
Reactivity: 0
Health: 3

Flash Point: NA

Extinguishing Media: dry sand, dry graphite, sodium chloride, or dry dolomite. Do not use water.

Flammable Limits: NA

Respiratory Protection: Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive-pressure mode.

Special Precautions: Move containers from the fire area if you can do so without risk. Cool containers that are exposed to flames with water from the side until well after fire is out.

SPILL, LEAK AND DISPOSAL PROCEDURES

Shut off ignition sources; do not permit flares, smoking or flames in hazard area.

Respiratory Protection: Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

Protective Equipment: Wear protective gloves and clothing and dust-proof goggles.

Small Spills: With a clean shovel place material into clean, dry container and cover; move containers from spill area.

Large Spills: Reclaim or dissolve in a flammable solvent and atomize in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

Disposal: See "Large Spills" above.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Improper use of respirators can be dangerous. Only respirators that have been approved by NIOSH or MSHA for exposures to manganese should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation.

For most purposes the full facepiece for metallic fumes or dust is acceptable (for air levels up to 10 times the recommended standard).

PROTECTIVE EQUIPMENT

Eye Protection: Dust-proof goggles.

Clothing: Protective gloves and clothing (suits, headgear, footwear).

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Manganese dust reacts with water or steam to produce highly flammable hydrogen.

INCOMPATIBILITIES

Manganese reacts violently with carbon dioxide, fluorine, chlorine, hydrogen peroxide, nitric acid, phosphorus, sulfur dioxide.

HAZARDOUS DECOMPOSITION PRODUCTS

Reacts with water or steam to produce hydrogen.

STORAGE

Manganese should be stored in tightly closed containers in a cool, well-ventilated area away from water, steam or oxidizers (see INCOMPATIBILITIES section).

PHYSICAL AND CHEMICAL DATA

Boiling Point: 2097°C (3806°F)
Melting Point: 1245°C (2273°F)
Vapor Pressure: 1 mmHg at 1227°C
Specific Gravity (water=1): 7.2

Molecular Weight: 54.94
Solubility in Water: insoluble
Evaporation Rate: NA
Vapor Density: NA

ADDITIONAL INFORMATION

Manganese's four principal uses are in: 1) the production of steel (and as an alloying agent for special steels, aluminum and copper); 2) the manufacture of dry cell batteries; 3) the production of potassium permanganate; and 4) electrode coating in welding rods.

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MASS MA 13.2 R245/2/CHEM

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

2-METHOXYETHANOL

(methyl cellosolve)

Synonyms: Methyl Cellosolve, Ethylene Glycol Methyl Ether, Methyl Oxitol Dowanol EM, EGME
C.A.S. Number: 109-86-4

Chemical Formula: $C_3H_8O_2$
Date Completed: 8/90

HAZARD SUMMARY

- **2-Methoxyethanol can affect you when inhaled or absorbed through the skin.**
- **2-Methoxyethanol can harm the reproductive systems of men and women by damaging the testes and/or the developing fetus.**
- **Prolonged exposure to 2-methoxyethanol may cause anemia and a reduced white blood cell count.**

GENERAL DESCRIPTION

2-Methoxyethanol is a clear, colorless liquid with a mild, pleasant odor. It is widely used as an industrial solvent for resins, lacquers, paints, and varnishes. It is also used in cleaning compounds, cosmetics, and fuel de-icing additives.

HEALTH HAZARD INFORMATION

Exposure to 2-methoxyethanol may occur by inhalation, ingestion, skin contact or eye contact.

ACUTE (short-term) HEALTH EFFECTS

2-Methoxyethanol can irritate the eyes, nose, throat and lungs, causing cough and/or shortness of breath.

2-Methoxyethanol can dissolve the skin's natural protective oils, causing dryness, redness, flaking, cracking and dermatitis.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #16,394 - 6pp. - 50cps. - 7/23/90
APPROVED BY: Ric Murphy, State Purchasing Agent

Higher levels of exposure may cause dizziness, disorientation, sluggishness, fatigue and headache.

CHRONIC (long-term) HEALTH EFFECTS

Prolonged exposures can cause anemia, low white blood cell count, depression of the bone marrow and possible suppression of the immune system.

Continued exposure may result in persistent headache, confusion, personality changes and a decline in intellectual function.

Repeated exposures may cause kidney damage.

Cancer Hazard: No information is currently available regarding 2-methoxyethanol's ability to cause cancer.

Reproductive Hazard: Animals exposed to 2-methoxyethanol have had decreased sperm count and abnormally-shaped sperm. Animal studies have also shown 2-methoxyethanol to harm the offspring. 2-Methoxyethanol has been shown to decrease the size of testicles in men working with the substance.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

No specific conditions.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations, made by NIOSH, may be more protective of human health, Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 25 ppm, averaged over an 8-hour workshift.

ACGIH: The recommended airborne exposure limit is 5 ppm, averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit is the lowest possible level.

The above exposure limits are for airborne levels only. When skin contact also occurs, one may become overexposed even though the airborne levels are less than the limits given above.

MEDICAL MONITORING

Workers with frequent or potentially high exposure to 2-methoxyethanol should receive a complete physical examination, including an occupational and medical history, at the beginning of employment and regularly thereafter. This test should include a complete blood count, a kidney function evaluation, and a reproductive system assessment.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Move the patient to fresh air immediately. If breathing has stopped, perform artificial respiration. Keep the person warm and at rest. Seek immediate medical attention.

Ingestion: Administer an emetic or use gastric lavage only if the patient is conscious. Give oxygen if respiration is depressed. These procedures should be done only by qualified medical personnel.

Skin: Remove contaminated clothing and shoes. Wash affected areas with soap and large amounts of water for at least 15 minutes. Get medical attention immediately.

Eyes: Wash the eyes immediately with large amounts of water, occasionally lifting upper and lower lids, for at least 15 minutes. Get medical attention immediately.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 2	Flash Point: 115°F (46°C)
Reactivity: 0	Extinguishing Media: Carbon dioxide, dry chemical, alcohol foam, water spray
Health: 2	Flammable Limits: lower-2.5%; upper-14%

Fire and Explosion Hazards: Moderate fire hazard when exposed to heat or flame. Vapors are heavier than air and may travel a long distance to the source of ignition and flash back.

Respiratory Protection: Any self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode; or any supplied-air respirator with full facepiece, operated in pressure-demand or other positive-pressure mode.

Protective Equipment: Solvent-resistant clothing and gloves to prevent skin contact.

Special Precautions: Move containers from fire area if possible. Cool fire-exposed containers with water from the side until after the fire is out.

SPILL, LEAK, AND DISPOSAL PROCEDURES

All ignition sources should be shut off, and the area of the spill or leak should be ventilated. Persons not wearing protective clothing should be kept away.

Small Spills: Absorb the liquid with fly ash, cement powder, or similar absorbent material, and deposit in sealed containers.

Large Spills: Dig a holding area such as a pit or lagoon to contain the spill, and dike suface flow with a barrier of soil, sandbags, or foamed polyurethane.

Disposal: Discharge the liquid at a controlled rate near a pilot flame to incinerate.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to 2-methoxyethanol should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

At any detectable concentration of 2-methoxyethanol, either of the following should be used:

Any self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode.

Any supplied-air respirator with full facepiece, operated in pressure-demand or other positive-pressure mode, in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

For escape, any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister may be used.

PROTECTIVE EQUIPMENT

Eye Protection: Splash-proof safety goggles.

Clothing: Solvent-resistant clothing, including gloves, to prevent contact of the liquid with the skin.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

2-Methoxyethanol is stable at normal temperatures and pressures, but it may become unstable at higher temperatures and pressures.

INCOMPATABILITIES

Forms explosive compounds when in contact with oxidizers. May attack plastics, rubber, and organic coatings.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition produces toxic gases, including carbon monoxide.

STORAGE

Store in tightly closed containers in a cool, well ventilated area, well away from heat and all sources of ignition.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 255°F (124°C)
Melting Point: -121°F (-85°C)
Vapor Pressure: 6 mmHg at 20°C
Specific Gravity: 0.97

Molecular Weight: 76.11
Solubility in Water: soluble
Evaporation Rate (butyl acetate=1): 0.5
Vapor Density: 2.6

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

The following information is available from the Massachusetts Department of Labor and Industries.

RIGHT TO KNOW INFORMATION

The Right to Know Program can answer questions about particular chemicals, training, labeling, and other Right to Know matters. Violations of the Right to Know Law should be reported to the nearest office of the Department of Labor and Industries.

PUBLIC PRESENTATIONS

Presentations and educational programs on occupational health or the Right to Know Law can be given for labor unions, trade associations and other groups.

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Upon recept of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

The Division of Occupational Hygiene has the names of various occupational health services and occupational physicians who are board-certified. This information is available upon request.

MASSACHUSETTS DEPARTMENT OF LABOR AND INDUSTRIES

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Pittsfield (413) 445-4214

MASS MA13.2:R245/2 / Methoxy. ace.

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

2-METHOXYETHANOL ACETATE

(methyl cellosolve acetate)

Synonyms: 2-Methoxyethyl acetate, Methyl cellosolve acetate, Ethylene glycol methyl ether acetate
C.A.S. Number: 110-49-6

Chemical Formula: $C_5H_{10}O_3$
Date Completed: 8/90

HAZARD SUMMARY

- **2-Methoxyethanol acetate can affect you when inhaled or absorbed through the skin.**
- **2-Methoxyethanol acetate can harm the reproductive systems of men and women by damaging the testes and/or the developing fetus.**
- **Prolonged exposure to 2-methoxyethanol acetate may cause anemia and a reduced white blood cell count.**

GENERAL DESCRIPTION

2-Methoxyethanol acetate is a clear, colorless liquid with a mild ether-like odor. It is used as a solvent for resins, oils, greases, and inks. It is also an ingredient of lacquers, paints, and adhesives.

HEALTH HAZARD INFORMATION

Exposure to 2-methoxyethanol acetate may occur by inhalation, ingestion, skin contact or eye contact.

ACUTE (short-term) HEALTH EFFECTS

2-Methoxyethanol acetate can irritate the eyes, nose, throat and lungs, causing cough and/or shortness of breath.

2-Methoxyethanol acetate can dissolve the skin's natural protective oils, causing dryness, redness, flaking, cracking and dermatitis.

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p1. Acute Health Effects
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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #16,400 - 6pp. - 50 cps. - 7/30/90
APPROVED BY: Ric Murphy, State Purchasing Agent

Higher levels of exposure may cause dizziness, disorientation, sluggishness, fatigue and headache.

CHRONIC (long-term) HEALTH EFFECTS

Prolonged exposures can cause anemia, low white blood cell count, depression of the bone marrow and possible suppression of the immune system.

Continued exposure may result in persistent headache, confusion, personality changes and a decline in intellectual function.

Repeated exposures may cause kidney damage.

Cancer Hazard: No information is currently available regarding 2-methoxyethanol acetate's ability to cause cancer.

Reproductive Hazards: Animals exposed to 2-methoxyethanol acetate have had decreased sperm count and abnormally-shaped sperm. Animal studies have also shown it to harm the offspring. 2-Methoxyethanol acetate has been shown to decrease the size of testicles in men working with the substance.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

No specific conditions.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations, made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The permissible airborne exposure limit is 25 ppm, averaged over an 8-hour workshift.

ACGIH: The recommended airborne exposure limit is 5 ppm, averaged over an 8-hour workshift.

The above exposure limits are for airborne levels only. When skin contact also occurs, one may become overexposed even though the airborne levels are less than the limits given above.

MEDICAL MONITORING

Workers with frequent or potentially high exposure to 2-methoxyethanol acetate should receive a complete physical examination, including an occupational and medical history, at the beginning of employment and regularly thereafter. This test should include a complete blood count, a kidney function evaluation, and a reproductive system assessment.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Move the patient to fresh air immediately. If breathing has stopped, perform artificial respiration. Keep the person warm and at rest. Seek immediate medical attention.

Ingestion: Administer an emetic or use gastric lavage only if the patient is conscious. Give oxygen if respiration is depressed. These procedures should be done only by qualified medical personnel.

Skin: Remove contaminated clothing and shoes. Wash affected areas with soap and large amounts of water for at least 15 minutes. Get medical attention immediately.

Eyes: Wash the eyes immediately with large amounts of water, occasionally lifting upper and lower lids, for at least 15 minutes. Get medical attention immediately.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 2	Flash Point: 111°F (44°C)
Reactivity: -	Extinguishing Media: Carbon dioxide, dry chemical, water spray, alcohol foam
Health: 1	Flammable Limits: lower - 1.7%; upper - 8.2%

Fire and Explosion Hazard: Moderate fire hazard when exposed to heat or flame. Vapors are heavier than air and may travel a considerable distance to source of ignition and flash back.

Respiratory Protection: Self-contained breathing apparatus with full facepiece, operated in pressure-demand or positive-pressure mode.

Protective Equipment: Impervious clothing, including gloves, to prevent skin contact.

Special Precautions: Move containers from fire area if possible. Cool fire-exposed containers with water from the side until after the fire is out.

SPILL, LEAK, AND DISPOSAL PROCEDURES

All ignition sources should be shut off, and the area of the spill or leak should be ventilated. Persons not wearing protective clothing should be kept away.

Small Spills: Absorb the liquid with fly ash, cement powder, or similar absorbent material, and deposit in sealed container.

Large Spills: Dig a holding area, such as a pit or lagoon, to contain the spill, and dike surface flow with a barrier of soil, sandbags, or foamed polyurethane.

Disposal: Discharge the liquid at a controlled rate near a pilot flame to incinerate.

EMERGENCY INFORMATION SOURCES

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PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to 2-methoxyethanol acetate should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be danagerous.

The following respiratory equipment should be used for protection against 2-methoxyethanol acetate at different airborne levels:

Airborne Concentration	Recommended Respirator
up to 50 ppm -	any supplied-air respirator, or
	any self-contained breathing apparatus.
up to 125 ppm -	supplied-air respirator operated in a continuous-flow mode.
up to 250 ppm -	supplied-air respirator with a full facepiece, or
	self-contained breathing apparatus with a full facepiece.
up to 4500 ppm -	type "C" supplied-air respirator with a full facepiece, operated in pressure-demand or other positive-pressure mode.
Escape -	gas mask with an organic vapor canister, or
	self-contained breathing apparatus.

Airborne Concentration	Recommended Respirator
Unknown concentration -	self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode, or supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode, in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

PROTECTIVE EQUIPMENT

Eye Protection: Splash-proof safety goggles.

Clothing: Impervious clothing, including gloves, to prevent contact of the liquid with the skin.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

2-Methoxyethanol acetate is stable at normal temperatures and pressures.

INCOMPATIBILITIES

Reacts vigorously with strong acids and alkalies, with oxidizing agents, and with nitrates.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition may release acrid smoke, irritating fumes, and toxic gases, including carbon monoxide.

STORAGE

Store in tightly closed containers in a cool, well ventilated area, well away from heat and all sources of ignition.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 292°F (144°C)
Melting Point: -94°F (-70°C)
Vapor Pressure: 2.0 mm Hg at 20°C
Specific Gravity: 1.0
Molecular Weight: 118.0
Solubility in Water: soluble
Evaporation Rate: NA
Vapor Density: 4.1

DEFINITIONS

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OCCUPATIONAL HEALTH AND SAFETY SERVICES

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MEDICAL EVALUATION

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Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

METHYLENE CHLORIDE

Synonyms: dichloromethane, methylene bichloride, methane dichloride
C.A.S. Number: 75-09-2

Chemical Formula: CH_2C1_2
Date Completed: 6/89

HAZARD SUMMARY

- Methylene chloride is a potential carcinogen and should be handled with extreme caution.
- Exposure to methylene chloride can cause irritation of the eyes, nose, throat and lungs. Severe lung irritation can lead to build-up of fluid in the lungs (pulmonary edema) which can cause death.
- Methylene chloride can cause dizziness, headaches and unconsciousness. Exposure to high concentrations can cause death.
- Phosgene, a highly toxic gas, may be formed when methylene chloride comes in contact with an open flame or hot metal.

GENERAL DESCRIPTION

Methylene chloride is a colorless, volatile liquid with a pleasant odor like that of ether. It is used as a solvent in paint removers, cleaners, and strippers, as an intermediate in the manufacture of chemicals, and in food processing, such as the decaffeination of coffee.

HEALTH HAZARD INFORMATION

Exposure to methylene chloride may occur by inhalation, ingestion, skin contact and eye contact.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #16007-6 pgs-50 cps 6/23/89
APPROVED BY: Ric Murphy, State Purchasing Agent

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Methylene chloride is irritating to the respiratory tract (nose, throat and lungs). It can also cause central nervous system depression, including drowsiness, dizziness, and lightheadedness. Significantly higher levels of exposure can cause loss of consciousness and death. Methylene chloride is changed to carbon monoxide in the body, and consequently can cause fatigue, shortness of breath, and heart pain.

Ingestion: The ingestion of methylene chloride can cause the same symptoms described for inhalation exposure.

Eye contact: Methylene chloride can cause pain and irritation of the eyes.

Skin contact: Methylene chloride can cause mild-to-severe irritation of the skin and burns. There is also slight absorption through the skin.

CHRONIC (long-term) HEALTH EFFECTS

Long-term exposure to methylene chloride may result in lung irritation and bronchitis, with cough and/or shortness of breath. The liver may also be damaged by long-term exposure. Memory loss, poor coordination and reduced ability to think may also result from damage to the brain. Repeated skin contact can cause thickening and cracking of the skin.

Cancer Hazard: Methylene chloride has been shown to cause cancer in rats and mice, but there is little information on the relationship between methylene chloride exposure and cancer in humans. It is classified as a potential occupational carcinogen.

Reproductive Hazard: In some studies, methylene chloride given to pregnant rodents has caused skeletal abnormalities and behavioral changes in the offspring. Methylene chloride may cause mutations.

Methylene chloride can convert to carbon monoxide in humans. Carbon monoxide can cause reduced fetal growth, and at high levels it may cause brain damage and fetal death.

Information on the reproductive effects of methylene chloride in humans is very limited. It may affect men's sperm. It crosses the placenta; and it passes into breast milk.

SPECIAL CONSIDERATIONS

Since methylene chloride is changed in the body to carbon monoxide, exposure to both carbon monoxide and methylene chloride will increase the possibility of carbon monoxide poisoning. Methylene chloride can form phosgene gas when it comes in contact with an open flame or hot metal. Phosgene gas can cause severe lung irritation and death.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Lung, liver and coronary artery disease, anemia and angina may be aggravated by exposure.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations, made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 500 ppm, averaged over an 8-hour workshift. An exposure of 1000 ppm should not be exceeded at any time, with the exception that a peak exposure of 2000 ppm for a period of 5-minutes is allowed in any 2-hour period. OSHA is considering changes in these limits.

ACGIH: The recommended airborne exposure limit is 50 ppm, averaged over an 8-hour workshift. An exposure of 100 ppm should not be exceeded during any 15-minute period.

NIOSH: The recommended airborne exposure limit is the lowest feasible concentration.

MEDICAL MONITORING

Pre-employment physicals should be performed. Lung, liver, and kidney function should be tested, and a complete blood count and carboxyhemoglobin level should be obtained. This exam should be repeated annually. If a person is acutely exposed, a carboxyhemoglobin, as well as liver and renal function tests, should be performed.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Move patient to fresh air. If patient is not breathing, begin artificial respiration. Get immediate medical attention.

Ingestion: Induce vomiting with ipecac syrup unless the patient is not awake. Get medical attention.

Skin contact: Remove contaminated clothing and shoes immediately. Wash affected areas with soap or mild detergent and large amounts of water until no evidence of the chemical remains (approximately 15-20 minutes).

Eye contact: Irrigate eyes with large amounts of water until no evidence of chemical remains (approximately 15-20 minutes). Get medical attention if irritation persists or if vision is impaired.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 1
Reactivity: 0
Health: 2

Flash Point: NA
Extinguishing Media: dry chemical or carbon dioxide; water spray or foam for larger fires
Flammable Limits: lower: 12%; upper: 19%

Respiratory Protection: For firefighting, a self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive-pressure mode should be used. The protection must meet the OSHA Standard 29 CFR 1910.156.

Protective equipment: Protective equipment for fire fighting must meet the OSHA standard 29 CFR 1910.156.

Special Precautions: The poisonous gases phosgene and hydrogen chloride are generated when methylene chloride burns in air. Respiratory protection must be appropriate for these substances.

SPILL, LEAK AND DISPOSAL PROCEDURES

All ignition sources should be shut off, and the area of the spill or leak should be ventilated. Persons not wearing protective equipment should be kept away.

Small Spills: The methylene chloride should be taken up with sand, vermiculite or dry earth, and deposited in sealed containers.

Large Spills: A dike should be erected far ahead of the spill before absorbing and disposal.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposure to methylene chloride should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes repirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

Any of the following forms of respiratory protection may be used for methylene chloride at any detectable concentration:

Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode;

Supplied-air respirator with full facepiece, operated in pressure-demand or other positive-pressure mode, in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Either of the following may be used for escape:

Any air-purifying full-faeepiece respirator (gas mask) with organie vapor canister;

Any appropriate escape-type self-eontained breathing apparatus.

PROTECTIVE EQUIPMENT

Eve Protection: Splash-proof safety goggles must be worn to prevent eye eontaet with methylene chloride.

Clothing: Appropriate impervious elothing (sueh as polyvinyl ehloride or viton) must be worn to prevent repeated or prolonged skin eontaet.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Although methylene ehloride is stable at ordinary temperatures and pressures, it ean become flammable at high temperature in an oxygen-rieh atmosphere.

INCOMPATIBILITIES

Methylene chloride reaets explosively in the pressenee of strong oxidizing agents and reactive metals sueh as sodium, potassium, aluminum, magnesium, zinc, and zirconium.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal deeomposition of methylene chloride may produee phosgene, hydrogen ehloride gas, and oxides of earbon.

STORAGE

Storage eontainers should be protected against physieal damage. They should be kept in a cool, dry, well ventilated location away from potential fire hazards.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 104°F (40°C)
Melting Point: -142°F (-95°C)
Vapor Pressure: 380 mm Hg @ 22°C
Specific Gravity (water=1): 1.3

Molecular Weight: 84.93
Solubility in Water: 2%
Evaporation Rate: (butyl aeetate=1) 27.5
Vapor Density: 2.9

DEFINITIONS

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MASS.
MA13.2:
R245/2/
nitric acid

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

NITRIC ACID

Synonyms: Nital, Engraver's Acid, UN2031 **Chemical Formula: HNO_3**
C.A.S. Number: 7697-37-2 **Date Completed: 8/88**

HAZARD SUMMARY

- **Inhaling nitric acid vapors can cause severe breathing problems and even death.**
- **Nitric acid is highly corrosive and can cause severe burns to the skin and eyes (and to the digestive system if swallowed).**
- **Nitric acid can erode the teeth.**

GENERAL DESCRIPTION

Nitric acid is a clear, colorless liquid with an acrid odor. It will yellow or darken upon aging or exposure to light.

HEALTH HAZARD INFORMATION

Exposure to nitric acid may occur by inhalation, ingestion, skin contact, and eye contact. Exposure can occur by contact with either the liquid or vapor form of nitric acid.

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Breathing nitric acid vapor can cause irritation to the breathing passages, resulting in a burning sensation of the nose, mouth, and throat, coughing and shortness of breath. These symptoms may disappear for several hours, but may be followed by severe difficulty breathing due to fluid accumulation in the lungs (pulmonary edema). At high levels of exposure death can occur.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #15,830-7pgs-50cps 2/21/89
APPROVED BY: Ric Murphy, State Purchasing Agent

Ingestion: Swallowing nitric acid can cause severe burns of the mouth, throat, esophagus, and stomach.

Skin contact: Nitric acid can cause skin burns.

Eye contact: Nitric acid solution can cause burns to the eye. Exposure to vapors can cause eye irritation and tearing.

CHRONIC (long-term) HEALTH EFFECTS

Long-term exposure to nitric acid can cause erosion of tooth enamel.

Cancer Hazard: Information is not currently available as to whether nitric acid is cancer-causing.

Reproductive Hazard: There is inadequate information to determine any reproductive effects of nitric acid.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Cigarette smoking may worsen the lung problems caused by nitric acid. Nitric acid may also aggravate certain skin and eye conditions.

MEDICAL MONITORING

Pre-employment histories should be taken of all workers exposed to nitric acid. A chest x-ray should be done in cases of overexposure to nitric acid.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 2 ppm, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 4 ppm.

NIOSH: The recommended airborne exposure limit is 2 ppm, averaged over a 10-hour workshift.

ACGIH: The recommended airborne exposure limit is 2 ppm, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 4 ppm.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Move person to fresh air. Oxygen should be given by medical personnel. Begin artificial respiration if breathing has stopped. Patient should be under medical supervision for 24-48 hours to monitor for breathing problems. Seek immediate medical attention.

Ingestion: Do not induce vomiting. Give large quantities of milk and then water to drink. Seek immediate medical attention.

Skin contact: Remove contaminated clothing and wash skin thoroughly with water. Apply a sterile, wet dressing to the affected area. Treat as a burn. Seek immediate medical attention.

Eye contact: Irrigate the eyes with water for at least 15 minutes, occasionally lifting upper and lower lids. Seek immediate medical attention.

FIRE AND EXPLOSION

Nitric acid presents a neglibible fire hazard when exposed to heat or flame. It is, however, an oxidizing material which increases the flammability of combustible, organic or other readily oxidizable materials.

NFPA Rating

Flammability: 0
Reactivity: 0
Health: 3

Flash Point: N.A.
Extinguishing Media: water, dry chemical or soda ash
Flammable Limits: NA

Respiratory Protection: Use a self-contained breathing apparatus with full facepiece operated in a pressure-demand or other positive-pressure mode. A supplied-air respirator with full facepiece operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode may also be used.

Protective Equipment: Impervious clothing and protective equipment should be used to prevent any possibility of skin contact with nitric acid.

Special Precautions: Stay upwind and keep out of low areas. Ventilate closed spaces before entering them. Dike to prevent runoff to sewers, as this can create fire and explosion hazard.

SPILL, LEAK AND DISPOSAL PROCEDURES

Small Spills: Keep combustibles away from spilled material. Do not touch nitric acid. Stop leak if you can do it without risk. Use a water spray to reduce vapors. Do not get water inside container, but flush area with flooding amounts of water.

Large Spills: Dike far ahead of spill to contain for later disposal. Keep unnecessary people away. Isolate the hazard area and deny entry to non-emergency personnel. Ventilate closed spaces before entering.

Disposal: If possible, neutralize spilled material to pH-7 with slaked lime, sodium bicarbonate or crushed limestone. Absorb liquids in vermiculite, dry sand, earth, or similar material and deposit in containers which can then be sealed. Check local regulations as it may be necessary to dispose of nitric acid as a hazardous waste.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are better than personal protective equipment. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

Local exhaust ventilation should be provided to all metal dip tanks containing nitric acid. The introduction of metals, particularly copper, causes a release of harmful quantities of nitrogen dioxide and nitric acid.

RESPIRATORY PROTECTION

Improper use of respirators can be dangerous. Only respirators that have been approved by NIOSH or MSHA for exposures to nitric acid should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. The following respirators and maximum concentrations are recommended:

Airborne Concentration	Recommended Respiratory Protection
50 ppm	-any supplied-air respirator operated in a continuous-flow mode.
100 ppm	-any self-contained breathing apparatus with a full facepiece. You may also use any supplied-air respirator with a full facepiece.

Airborne Concentration	Recommended Respiratory Protection
100 ppm	Also, any air-purifying full facepiece respirator (gas mask) with a chin style or front-or-back-mounted canister providing protection against the compound of concern can be used.
Escape	-Any air-purifying full facepiece respirator (gas mask) with a chin style or front- or back-mounted canister providing protection against the compound of concern can be used. Any appropriate escape-type self-contained breathing apparatus may also be used.

Note: only non-oxidizable sorbents are allowed (not charcoal).

PROTECTIVE EQUIPMENT

Eye Protection: Employees must wear splash-proof or dust resistant safety goggles and a face shield to prevent contact with this substance. Where there is any possibility that an employee's eyes may be exposed to nitric acid, the employer shall provide an eye-wash fountain within the immediate work area for emergency use.

Clothing Protection: Employees must wear appropriate impervious clothing and protective gloves to prevent contact with nitric acid.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

This material is stable under normal storage and handling conditions. It is hydroscopic (in concentrated form) and a strong acid and oxidizing agent.

INCOMPATIBILITIES

Nitric acid reacts violently with alcohol, turpentine, charcoal, and organic refuse. It reacts explosively with metallic powders, carbides, and hydrogen sulfide. Combining nitric acid with powerful reducing agents may also cause explosion. Moisture and heat should be avoided.

HAZARDOUS DECOMPOSITION PRODUCTS

Nitric acid will react with water or steam to produce heat, and toxic and corrosive fumes. Nitric acid and materials such as wood, wood shavings, saw dust, or metals (particularly copper) will react to produce toxic levels of nitric oxide and nitrogen dioxide.

STORAGE

Store this substance in a clean, cool, well-ventilated place. Keep away from incompatible materials. Protect this substance from direct sunlight. Neutralizing and absorbing materials such as soda ash and sand should be readily available to areas of use or storage of nitric acid.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 181°F (83°C)
Melting Point: -44°F (-42°C)
Vapor Pressure: 47.8 mmHg at 20°C
Specific Gravity (water=1): 1.504
Molecular Weight: 63.02
Solubility in Water: soluble
Evaporation Rate: N.A.
Vapor Density: 2.2

ADDITIONAL INFORMATION

Nitric acid is nonflammable; however it is a strong oxidizing agent and can react with combustible materials to cause fires. Use water on fires involving nitric acid to dilute the acid and to absorb liberated oxides of nitrogen. It can also react with metals to liberate flammable hydrogen gas.

Nitric acid is used in the manufacture of organic and inorganic nitrates, many different organic chemicals, dye intermediates, pharmaceuticals, jewelry and explosives.

Chemical safety showers and eyewash stations must be readily available in areas of storage and handling of nitric acid.

Reportable Quantity: 1000 pounds

The Superfund Amendments and Reauthorization Act (SARA) of 1986 (section 304) requires that a release equal to or greater than the reportable quantity for this substance must be immediately reported to the Local Emergency Planning Committee, the State Emergency Response Commission, and the National Response Center (800) 424-8802.

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

The following information is available from the Massachusetts Department of Labor and Industries.

RIGHT TO KNOW INFORMATION

The Right to Know Program can answer questions about particular chemicals, training, labeling, and other Right to Know matters. Violations of the Right to Know Law should be reported to the nearest office of the Department of Labor and Industries.

PUBLIC PRESENTATIONS

Presentations and educational programs on occupational health or the Right to Know Law can be given for labor unions, trade associations and other groups.

OCCUPATIONAL HEALTH AND SAFETY SERVICES

Upon recept of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

The Division of Occupational Hygiene has the names of various occupational health services and occupational physicians who are board-certified. This information is available upon request.

MASSACHUSETTS DEPARTMENT OF LABOR AND INDUSTRIES

Division of Occupational Hygiene

West Newton (617) 969-7177

Division of Industrial Safety

Boston (617) 727-3460
Lawrence (617) 681-7798
New Bedford (617) 997-8263
Springfield (413) 734-1421
Worcester (617) 752-6504
Pittsfield (413) 445-4214

MASS.
MA13.2:
R245/21
nitric ox.

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

NITRIC OXIDE

Synonyms: Nitrogen monoxide, nitrogen oxide, nitrosyl radical
C.A.S. Number: 10102-43-9

Chemical Formula: NO
Date Completed: 2/89

HAZARD SUMMARY

- Nitric oxide can affect you when inhaled or by passing through your skin.
- Nitrogen dioxide, which is spontaneously converted from nitric oxide in the air, is thought to be the agent responsible for toxic effects.
- Inhalation of nitric oxide may produce no immediate reaction. Delayed reaction in 4 to 12 hours may include difficulty breathing, choking, dizziness, and even death. If a person makes an apparent recovery, a second acute phase may occur after several weeks with the same symptoms.

GENERAL DESCRIPTION

Nitric oxide is a colorless, toxic, nonflammable gas with a sharp, sweet odor. It is an important intermediate in the manufacture of nitric acid. It is also a raw material for nitrosyl halide manufacture, and a bleach for rayon. It reacts spontaneously in air to form nitrogen dioxide, an even more toxic compound.

HEALTH HAZARD INFORMATION

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Inhalation usually does not produce immediate, pronounced irritation of the respiratory tract. Headache, dizziness, nausea, vomiting, and some respiratory tract irritation may occur following exposure to 60 ppm. Difficulty breathing, choking, dizziness, headache, bluish discoloration of the skin, restlessness and even death may follow in 4 to 12 hours. Patients who recover may have a brief

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1001 Watertown Street, West Newton, MA 02165

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period of 2 to 4 weeks without any symptoms. A second acute phase may follow with coughing, difficulty breathing, fever, increased heart rate, and bluish discoloration of the skin. This relapse may lead to death or to a slow recovery complicated by pneumonia.

Skin Contact: May cause irritation.

Eye Contact: May cause irritation.

CHRONIC (long-term) HEALTH EFFECTS

Inhalation: Repeated or prolonged exposure to low concentrations of nitric oxide may cause chronic irritation of the respiratory tract with sporadic coughing, wheezing, difficulty breathing, chronic lung disease, and bluish discoloration of the skin.

Skin Contact: Repeated or prolonged exposure to nitric oxide may cause dermatitis and yellowish or brownish staining of the skin.

Eye Contact: Repeated or prolonged contact to nitric oxide may cause conjunctivitis.

Cancer Hazard: Information is not available to determine whether nitric oxide is a carcinogen.

Reproductive Hazard: Very limited information is available on the reproductive effects of nitric oxide. One experimental study has indicated that exposure of rats to nitric oxide results in an increased mutation rate in their lung cells.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Not available.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations, made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 25 ppm, averaged over an 8-hour workshift.

ACGIH: The recommended airborne exposure limit is 25 ppm, averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit is 25 ppm, averaged over a 10-hour workshift.

MEDICAL MONITORING

Employees should have initial and annual medical exams, including special attention to the nervous system, respiratory tract and cardiovascular system.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Remove the individual from exposure area to fresh air immediately. If breathing has ceased, properly trained personnel should begin artificial respiration or cardiopulmonary resuscitation (CPR) immediately. Get medical attention immediately.

Skin Contact: Remove contaminated clothing immediately. Wash affected areas with soap or mild detergent and large amounts of water for 15-20 minutes. Get medical help immediately.

Eye Contact: Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids (for at least 15-20 minutes). Get medical attention immediately.

FIRE AND EXPLOSION

NFPA Rating: NA

Flash Point: NA

Extinguishing Media: Dry chemical, carbon dioxide, water spray, foam

Flammable Limit: NA

Respiratory Protection: Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode, or supplied-air respirator with full facepiece, operated in pressure-demand or other positive-pressure mode.

Protective Clothing: Impervious clothing (made of butyl rubber or PVC) should be worn to prevent skin contact.

Special Precautions: Move container from fire area if possible. Stay away from storage tank ends. Cool fire-exposed containers with water from the side until well after the fire is out. Evacuate downwind area if container is leaking.

SPILL, LEAK AND DISPOSAL PROCEDURES

Spills: Stop the gas leak if possible without risk. Keep combustibles away from the leaked material. Keep unnecessary people away. Isolate the area and deny entry until the gas has dispersed. Ventilate closed spaces before entering.

Federal law requires that a leak of more than 10 pounds of nitric oxide be reported to the State Emergency Response Commission, the local Fire Department, and the local Emergency Planning Committee.

Disposal: Incinerate with added hydrocarbon fuel and air, or bubble through an adequate amount of alkaline potassium permanganate solution.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to nitric oxide should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

The following respiratory equipment is recommended for the indicated airborne levels:

Gas Concentration	Recommended Respiratory Protection
100 ppm or less	Any chemical cartridge respirator with full facepiece and cartridges with non-oxidizable sorbents that provide protection against nitric oxide.
	A gas mask with a chin-style or a front- or back-mounted canister with non-oxidizable sorbents that provide protection against nitric oxide.
	Any supplied-air respirator with full facepiece, helmet, or hood.
	Any self-contained breathing apparatus with full facepiece.
Greater than 100 ppm	Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode.
	A combination respirator that includes a Type C supplied-air respirator with full facepiece, operated in pressure-demand or other positive-pressure mode, and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

PROTECTIVE EQUIPMENT

Eye Protection: Splash-proof goggles should be worn to prevent eye contact. Contact lenses should not be worn.

Clothing: Impervious clothing, including gloves (made of butyl rubber or PVC), should be worn to prevent repeated or prolonged skin contact.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Nitric oxide hydrolyzes in water to form nitric and nitrous acids.

INCOMPATIBILITIES

Nitric oxide reacts violently with many organic and inorganic materials, including ammonia, boron trichloride, carbon disulfide, saturated and unsaturated hydrocarbons, sulfur, fluorine, halogenated hydrocarbons, and metals. It may also attack plastics, rubber, and coatings.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition produces toxic oxides of nitrogen.

STORAGE

Store away from sources of heat and incompatible substances. Observe all federal, state, and local regulations when storing nitric oxide.

PHYSICAL AND CHEMICAL DATA

Boiling Point: -241°F (-152°C)
Melting Point: -263°F (-164°C)
Vapor Pressure: 26,000 mmHg at 20°C
Specific Gravity: 1.33 at -90°C (liquid)

Molecular Weight: 30.0
Solubility in Water: 7.3% at 0°C
Evaporation Rate: NA
Vapor Density: 1.6

ADDITIONAL INFORMATION

Nitric oxide is formed as a by-product of oxy-gas welding processes, and is a combustion product of most fires. A common source of exposure is the exhaust gas of internal combustion engines.

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects. miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

The following information is available from the Massachusetts Department of Labor and Industries.

RIGHT TO KNOW INFORMATION

The Right to Know Program can answer questions about particular chemicals, training, labeling, and other Right to Know matters. Violations of the Right to Know Law should be reported to the nearest office of the Department of Labor and Industries.

PUBLIC PRESENTATIONS

Presentations and educational programs on occupational health or the Right to Know Law can be given for labor unions, trade associations and other groups.

OCCUPATIONAL HEALTH AND SAFETY SERVICES

Upon recept of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

The Division of Occupational Hygiene has the names of various occupational health services and occupational physicians who are board-certified. This information is available upon request.

MASSACHUSETTS DEPARTMENT OF LABOR AND INDUSTRIES

Division of Occupational Hygiene

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Division of Industrial Safety

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Springfield (413) 734-1421
Worcester (617) 752-6504
Pittsfield (413) 445-4214

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

NITROGEN DIOXIDE

Synonyms: Nitrogen peroxide, nitrite radical

Chemical Formula: NO_2

C.A.S. Number: 10102-44-0

Date Completed: 6/89

HAZARD SUMMARY

- **Nitrogen dioxide can affect you when inhaled or by absorption through your skin or by swallowing the liquid.**
- **Exposure to nitrogen dioxide may cause severe breathing difficulties and may cause death.**
- **Exposure to nitrogen dioxide may cause reproductive effects.**

GENERAL DESCRIPTION

Nitrogen dioxide is a reddish-brown gas or yellowish-brown liquid with a pungent, acrid odor. It is used in the synthesis of organic compounds and nitric acid, as an oxidizer in liquid rocket fuel, and in the manufacture of liquid explosives.

HEALTH HAZARD INFORMATION

Exposure to nitrogen dioxide may occur by inhalation, ingestion, skin contact or eye contact.

ACUTE (short-term) HEALTH EFFECTS

Inhalation: May cause irritation of the mucous membranes. Acute over-exposure to levels greater than 50-100 ppm may cause severe breathing difficulties which usually appear after some delay, and may cause death. Recovery may be slow (two-to-three weeks), with possible recurrence of symptoms and permanent lung damage. Acute over-exposure may also produce immediate fatigue, chills, fever, malaise, nausea and vomiting. Short-term exposure to lower levels of nitrogen dioxide may cause mild signs of chest irritation. However, delayed symptoms of fluid in the lungs (shortness of breath, cyanosis and chest tightness) may occur within eight-to-twelve hours following initial exposure.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

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Skin Contact: Direct contact with the liquid may cause severe irritation, pain, yellow-brown discoloration, or burns.

Eye Contact: Direct contact with the liquid may cause severe irritation with redness, pain, blurred vision, swelling of the eyelids, or burns.

Ingestion: Ingestion of the liquid may cause an acid taste, nausea, vomiting, abdominal pain and damage to the lips and mouth.

CHRONIC (long-term) HEALTH EFFECTS

Inhalation: Prolonged exposure to low concentrations of nitrogen dioxide may cause chronic irritation of the respiratory tract (with cough, increased sputum production, difficulty breathing with exertion) and headache, dizziness, ulcers of the nose and mouth, and loss of appetite.

Skin Contact: Repeated or prolonged contact with nitrogen dioxide may cause dermatitis or effects similar to those of acute exposure.

Eye Contact: Repeated or prolonged contact with nitrogen dioxide may cause conjunctivitis or effects similar to those of acute exposure.

Ingestion: No data available.

Cancer Hazard: Information is not available to determine whether nitrogen dioxide is a cancer-causing agent.

Reproductive Hazard: Limited information is available on the reproductive effects of nitrogen dioxide. Limited studies on rats indicate that it may affect their reproductive cycle and the health of their offspring. Nitrogen dioxide may also be a mutagen. Information is not available on the reproductive effects of nitrogen dioxide in humans.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

People with asthma, emphysema or chronic bronchitis appear to be at some increased risk for symptomatic flare-ups with nitrogen dioxide exposure.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations, made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal short-term exposure limit, not to be exceeded in any 15-minute period, is 1 ppm.

ACGIH: The recommended airborne exposure limit is 3 ppm, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 5 ppm.

NIOSH: The recommended short-term exposure limit, not to be exceeded during any 15-minute period, is 1 ppm.

MEDICAL MONITORING

Employees should have initial and annual medical exams with special attention to the respiratory tract and cardiovascular system. Annual pulmonary function tests and a respiratory questionnaire should be provided.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Remove the individual from exposure area to fresh air immediately. If breathing has ceased, properly trained personnel should begin artificial respiration or cardiopulmonary resuscitation (CPR) immediately. Get definitive medical attention immediately.

Skin Contact: Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). In case of chemical burns, cover area with sterile, dry dressing. Get medical attention immediately.

Eye Contact: Wash eyes immediately with large amounts of clean water, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). In case of burns, apply sterile bandages loosely to both eyes without medication. Get medical attention immediately.

Ingestion: Get medical attention immediately. If vomiting occurs, keep head lower than hips to prevent aspiration.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 0
Reactivity: 0
Health: 3

Flash Point: NA
Extinguishing Media: Dry chemical, carbon dioxide, halon, water spray, foam
Flammable Limits: NA

Respiratory Protection: For firefighting, either of the following may be used: a self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode; or a supplied-air respirator with full facepiece, operated in pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Protective Equipment: For the gas form, no protective clothing is required. Protective clothing, including cold-insulating gloves, is required if contact with the liquid is possible.

Fire and Explosion Hazard: Although nitrogen dioxide is not flammable, storage tanks that contain the substance in liquid form may easily explode in a fire, releasing the highly toxic gas.

SPILL, LEAK AND DISPOSAL PROCEDURES

Since the boiling point of nitrogen dioxide is near room temperature, spills may contain a mixture of the liquid and the gas. The area of the spill should be ventilated. Persons not wearing protective equipment should be kept away.

Small Spills: Absorb the liquid with fly ash or cement powder. Use water spray to knock down and reduce vapors. The knock-down water, which is corrosive, should be diked for containment.

Large Spills: Dig a holding area such as a pit, pond, or lagoon to contain the liquid. Dike surface flow with a barrier of soil, sandbags, or foamed polyurethane. Neutralize the spill with slaked lime, sodium bicarbonate, or crushed limestone. Use water spray for the vapors.

Federal law requires that a leak or spill of more than 10 pounds of nitrogen dioxide be reported to the State Emergency Response Commission, the local Fire Department, and the local Emergency Planning Committee.

Disposal: A leaking container should be moved to a hood or safe out-of-doors area. A long piece of flexible tubing should be attached so that the nitrogen dioxide can be directed into a 5-10 percent sodium hydroxide solution. The solution should then be transferred to an appropriate disposal site for neutralization.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to nitrogen dioxide should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

The following respiratory equipment is suitable for the indicated airborne levels:

Airborne Concentration	Recommended Respiratory Protection
25 ppm or less	Any supplied-air respirator operated in a continuous-flow mode.
50 ppm or less	Any self-contained breathing apparatus with full facepiece; any supplied-air respirator with full facepiece.
Escape	Any air-purifying full-facepiece respirator (gas mask) with a chin-style or front or back-mounted canister providing protection against nitrogen dioxide; any appropriate escape-type self-contained breathing apparatus.

No oxidizable sorbents may be used.

PROTECTIVE EQUIPMENT

Eye Protection: For the gas form, eye protection is recommended. Splash-proof goggles and a faceshield are required if contact with the liquid is possible.

Clothing: If contact with the liquid is possible, protective clothing, including cold-insulating gloves, is required to prevent skin contact.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Nitrogen dioxide alone is stable at normal temperatures and pressures. However, it is extremely reactive with many substances.

INCOMPATIBILITIES

Nitrogen dioxide may react explosively with ammonia, oxidizing and reducing agents, many organic compounds including the relatively inert halocarbons, fuels, and many metals. It will corrode steel when wet, and may attack plastics, rubber, and coatings.

HAZARDOUS DECOMPOSITION PRODUCTS

Nitrogen dioxide is extremely toxic in itself, and may form other toxic oxides of nitrogen on thermal decomposition.

STORAGE

Containers should be protected against physical damage and heat, and stored away from combustible, organic, or other readily oxidizable substances. Transfer facilities should be located out of doors. Because nitrogen dioxide is extremely corrosive when wet, proper materials of construction are necessary.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 70°F (21°C)
Melting Point: 12°F (-11°C)
Vapor Pressure: 720 mmHg at 20°C
Specific Gravity: 1.45
Molecular Weight: 46.0
Solubility in Water: decomposes
Evaporation Rate: NA
Vapor Density: 1.58

ADDITIONAL INFORMATION

Most occupational exposures to nitrogen dioxide result from its presence as a by-product of reactions of nitric acid with reducing agents, from processes in which air is heated to a high temperature, and from the exhaust of internal-combustion engines.

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

The following information is available from the Massachusetts Department of Labor and Industries.

RIGHT TO KNOW INFORMATION

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PUBLIC PRESENTATIONS

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OCCUPATIONAL HEALTH AND SAFETY SERVICES

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MEDICAL EVALUATION

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MASS.
MA13.2:
R245/2/
nitr. oxid.

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

NITROUS OXIDE

Synonyms: Laughing gas, dinitrogen oxide, nitrogen (1) oxide

Chemical Formula: N_2O

CAS Number: 10024-97-2

Date Completed: 8/88

HAZARD SUMMARY

- Nitrous oxide causes adverse health effects when it is inhaled.
- Short-term exposure can cause lightheadedness, sleepiness, and giddiness. At higher levels nitrous oxide can cause unconsciousness or even death.
- Long-term exposure to nitrous oxide can cause nervous system damage, with loss of sensation, weakness and emotional instability.
- Nitrous oxide is an anesthetic gas; as a group, these agents are known to cause cancer. It is not known if nitrous oxide causes cancer.

GENERAL DESCRIPTION

Nitrous oxide is a colorless gas with a slightly sweetish odor and taste. It is used as an anesthetic, as a propellant for whipped cream dispensers, in some rocket fuels, and in the synthesis of organic compounds.

HEALTH HAZARD INFORMATION

Exposure to nitrous oxide may occur by inhalation or by skin or eye contact with the liquefied gas.

ACUTE (short-term) HEALTH EFFECTS

Acute exposure to nitrous oxide can cause lightheadedness, drowsiness, and giddiness. At higher levels it can cause unconsciousness, and at very high levels can cause death. At high levels of exposure, nitrous oxide will decrease the amount of oxygen available for breathing.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #15,829-6pgs-50cps 2/21/89
APPROVED BY: Ric Murphy, State Purchasing Agent

CHRONIC (long-term) HEALTH EFFECTS

Long-term exposure to nitrous oxide can cause damage to the nervous system. Such damage can occur after as little as three months of exposure. This is manifested by "pins and needles" sensation, numbness, loss of pain and temperature sensation, leg weakness, loss of balance, uncoordinated walking, impotence, and loss of bladder and vaginal sensation.

Exposure to nitrous oxide can cause damage to red blood cells.

Cancer Hazard: Nitrous oxide is used as an anesthetic agent for surgery. Anesthetic agents are believed to cause cancer; however, specific information is not currently available as to whether nitrous oxide causes cancer.

Reproductive Hazard: Pregnant rats exposed to nitrous oxide have had miscarriages and decreased size and skeletal abnormalities of the offspring and other reproductive effects. In a limited number of studies, male rats exposed to nitrous oxide have had a decrease in testicular weight and in the number of sperm.

Human studies have shown an increase in miscarriages, stillbirths and birth defects in the offspring of women and men exposed to anesthetic agents. However, these studies do not discriminate between the different anesthetics used.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

There are no specific medical conditions aggravated by exposure to nitrous oxide.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: No exposure limits have been set.

ACGIH: The recommended airborne exposure limit (proposed for 1988) is 50 ppm, averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit is 25 ppm, averaged over a 10-hour workshift.

MEDICAL MONITORING

Pre-employment and periodic medical histories and physical exams should be performed on workers who will be exposed to nitrous oxide frequently or at high levels. A complete blood count and nerve conduction studies may be useful in cases of overexposure.

EMERGENCY INFORMATION

FIRST AID

Inhalation: In case of inhalation, remove patient from the contaminated area to fresh air. Give artificial respiration if the patient is not breathing. Seek immediate medical attention.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 0
Reactivity: 0
Health: 3

Flash Point: NA
Extinguishing Media: Dry chemical, carbon dioxide, or water spray
Flammable Limits: NA

Respiratory Protection:

For firefighting, a self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive-pressure mode should be used.

Protective Equipment:

No special precautions are needed.

Special Precautions:

Although nitrous oxide is not readily flammable, it is an oxidizer, and will increase the intensity of any fire. Containers may explode in a fire.

SPILL, LEAK, AND DISPOSAL PROCEDURES

Keep combustible, such as wood, paper, and oil, away from the hazard area. Stop the leak if it can be done without risk. Isolate the area and ventilate to allow the gas to disperse. If the flow cannot be stopped, attempt to direct it into a mixture of caustic soda and slaked lime, and dispose of the resulting material in a hood.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to nitrous oxide should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

Either of the following forms of respiratory protection may be used for nitrous oxide:

Type "C" supplied-air respirator with a full facepiece, operated in pressure-demand or other positive-pressure mode, or with a full facepiece, helmet, or hood operated in continuous-flow mode.

Self-contained breathing apparatus with a full facepiece, operated in pressure-demand or other positive-pressure mode.

PROTECTIVE EQUIPMENT

Eye Protection: Eye protection is not required for the gas form of nitrous oxide. If there is the possibility of contact with the liquid form, splash-proof safety goggles and a faceshield must be worn.

Clothing: If there is the possibility of contact with the liquid, appropriate protective clothing, including gloves, must be worn to prevent the skin from freezing.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Nitrous oxide is stable at normal temperatures and pressures. Above 300°C it may decompose and act as an oxidizer.

INCOMPATIBILITIES

Nitrous oxide may react explosively with ammonia, hydrogen, hydrogen sulfide, phosphine, hydrazine, liquid carbon monoxide, or lithium hydride. Ignition may occur on heating with boron, tin oxide, or tungsten carbide.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition may generate toxic oxides of nitrogen.

STORAGE

Cylinders of nitrous oxide should be stored in a cool, fire-resistant area, away from heat sources and materials with which it is incompatible.

PHYSICAL AND CHEMICAL DATA

Boiling Point: -127°F (-80°C)
Melting Point: NA
Vapor Pressure: NA
Specific Gravity (water=1): 0.91 (0°C)

Molecular Weight: 44.01
Solubility in Water: Slightly soluble
Evaporation Rate: NA
Vapor Density: 1.5

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

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ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

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The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

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RIGHT TO KNOW INFORMATION

The Right to Know Program can answer questions about particular chemicals, training, labeling, and other Right to Know matters. Violations of the Right to Know Law should be reported to the nearest office of the Department of Labor and Industries.

PUBLIC PRESENTATIONS

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OCCUPATIONAL HEALTH AND SAFETY SERVICES

Upon recept of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

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MASS.
HA 13.2:
R245/2/
Phosphi,

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

PHOSPHINE

Synonyms: Hydrogen phosphide, phosphorus trihydride
Chemical Formula: PH_3
CAS Number: 7803-51-2
Date Completed: 10/88

HAZARD SUMMARY

- **Phosphine causes adverse health effects when it is inhaled.**
- **Short-term exposure may cause nausea, vomiting, headache, fatigue, shortness of breath and cough.**
- **At higher levels, phosphine may cause seizures or coma, or even death.**
- **A dangerous accumulation of fluid in the lungs may occur 12 to 48 hours after high-dose exposure to phosphine.**

GENERAL DESCRIPTION

Phosphine is a colorless gas with a disagreeable fishy or garlic-like odor. It is used primarily as a dopant in the manufacture of semiconductor devices and integrated circuit chips. It is also used as a grain fumigant and in the manufacture of organic compounds.

HEALTH HAZARD INFORMATION

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Acute exposure to phosphine may cause mucous membrane irritation, nausea, vomiting, abdominal pain, headache, fatigue, dizziness, shortness of breath and cough. At higher levels, it can cause convulsions, irregular heart beat and coma; and can affect the kidneys and liver. A dangerous build-up of fluid in the lungs may occur 12 to 48 hours after high exposure. At very high levels phosphine can cause death.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

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APPROVED BY: Ric Murphy, State Purchasing Agent

Skin or eye exposure: Exposure to the liquified gas may cause frostbite, pain and redness.

CHRONIC (long-term) HEALTH EFFECTS

Information is not currently available on chronic effects of phosphine.

Cancer Hazard: Information is not available to determine a cancer hazard.

Reproductive Hazard: Information is not available to determine a reproductive hazard.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Because of its irritant effects, phosphine may worsen symptoms of people who have impaired pulmonary function.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 0.3 ppm, averaged over an 8-hour workshift.

ACGIH: The recommended airborne exposure limit is 0.3 ppm, averaged over an 8-hour workshift. The recommended short-term exposure limit, not to be exceeded during any 15-minute period, is 1 ppm.

MEDICAL MONITORING

Pre-employment and periodic medical histories and physical exams should be performed on workers who will be exposed to phosphine. Persons who have impaired pulmonary function may be at increased risk from exposure to phosphine.

EMERGENCY INFORMATION

FIRST AID

Inhalation: In case of inhalation, remove the person from the contaminated area to fresh air immediately. Give artificial respiration if the person is not breathing. Seek immediate medical attention. Delayed pulmonary edema is a possible outcome. A person should be observed for 48 hours after exposure if poisoning is suspected.

Skin: Remove contaminated clothing and shoes immediately. Wash affected area with soap and large amounts of water for 15 to 20 minutes. Get medical attention immediately.

Eyes: Wash eyes immediately with large amounts of water for 15 to 20 minutes. Get medical attention immediately.

FIRE AND EXPLOSION

NFPA Rating
Flammability: 4
Reactivity: 1
Health: 3

Flash Point: Flammable gas
Extinguishing Media: dry chemical, CO_2, water spray or foam
Flammable Limits: lower = 1%; upper - NA

Respiratory Protection: Self-contained breathing apparatus with a full facepiece, operated in pressure-demand or other positive-pressure mode.

Protective Equipment: No special precautions for exposure to the gas.

Special Precautions: Move container from fire area if possible. Cool containers from the side until fire is out. Stay away from tank ends. Use water as a fog, rather than a solid stream, from as far away as possible. Remain upwind.

SPILL, LEAK AND DISPOSAL PROCEDURES

Ignition sources should be shut off. The leak should be stopped if it can be done without risk. The area should be isolated until gas has dispersed. No smoking, flames, or flares are to be allowed. Closed spaces should be ventilated before entering.

Respiratory Protection: Self-contained breathing apparatus with a full-facepiece, operated in pressure-demand or other positive-pressure mode.

Protective Equipment: No special precautions for exposure to the gas.

Disposal: Once the leak has been stopped, the gas must be allowed to disperse into the atmosphere.

EMERGENCY INFORMATION SERVICES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are better than personal protective equipment. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation, and others. However, for some jobs (such as outside work, confined-space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Improper use of respirators can be dangerous. Only respirators that have been approved by NIOSH or MSHA for exposure to phosphine should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation.

The recommended types of respirators are shown in the following table:

Gas Concentration	Minimum Respiratory Protection
3 ppm or less	Any chemical cartridge respirator providing protection against phosphine.
15 ppm or less	A chemical cartridge respirator with full facepiece and a cartridge providing protection against phosphine.
200 ppm or less	Type-C supplied-air respirator operated in pressure-demand or other positive-pressure mode.
Greater than 200 ppm or unknown	Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive-pressure mode.
Escape	Any gas mask providing protection against phosphine.

PROTECTIVE EQUIPMENT

Eye Protection: Not applicable

Clothing: No special precautions for exposure to the gas. If contact with the liquid is possible, wear appropriate clothing to prevent skin from freezing.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Phosphine is subject to spontaneous combustion above room temperature. The liquified gas may be detonated by a powerful impact. It may spontaneously react violently in air or with moisture.

INCOMPATIBILITIES

Phosphine reacts spontaneously, and often explosively, with acids, halogens, halogenated hydrocarbons, and oxidants.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition may release toxic oxides of phosphorus.

STORAGE

Phosphine storage tanks should be kept in a cool, dry, well-ventilated area.

PHYSICAL AND CHEMICAL DATA

Boiling Point: -125°F (-88°C)
Melting Point: -209°F (-134°C)
Vapor Pressure: gas at room temperature
Specific Gravity (water = 1): 0.75 at -126°F
Molecular Weight: 34.04
Solubility in Water: 26% at 17°C
Evaporation Rate: NA
Vapor Density: 1.17

DEFINITIONS

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MASS MA13.2:R45/2/Phos.Oxychl.

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

PHOSPHORUS OXYCHLORIDE

Synonyms: phosphoryl chloride, phosphoric trichloride
Chemical Formula: $POCl_3$
CAS Number: 10025-87-3
Date Completed: 10/89

GOVERNMENT DOCUMENTS COLLECTION 1990 University of Massachusetts Depository Copy

HAZARD SUMMARY

- **Phosphorus oxychloride can affect you when inhaled or swallowed or by contact with the skin.**
- **When inhaled, exposure can cause sore throat, dizziness, and difficulty breathing. Delayed lung and kidney damage may occur.**
- **Skin and eye contact may lead to inflammation, pain, and severe burns.**

GENERAL DESCRIPTION

Phosphorus oxychloride is a clear, colorless to pale yellow, strongly fuming, oily liquid with an odor similar to that of hydrogen chloride. It is used as a dopant in the manufacture of semiconductor devices and integrated circuits, and in the manufacture of organic chemicals and fire-retarding agents.

HEALTH HAZARD INFORMATION

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Acute exposure may cause sore throat, cough, dizziness, headache, weakness, nausea, vomiting, chest pain, and difficulty breathing. Delayed pulmonary edema (fluid in the lungs), causing shortness of breath and kidney damage, may occur.

Skin Contact: Exposure may cause inflammation, pain, skin discoloration and, in extreme cases, severe burns.

Eye Contact: It is highly corrosive to the eyes, and exposure to vapors may lead to inflammation, pain, tearing, and blurred vision, and contact with the liquid can cause burns.

Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

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PUBLICATION: #16079-6pgs-50cps-10/16/89
APPROVED BY: Ric Murphy, State Purchasing Agent

Ingestion: Liquid phosphorus oxychloride irritates the mucous membranes and may cause sore throat, stomach pain, nausea, vomiting, and diarrhea.

CHRONIC (long-term) HEALTH EFFECTS

Inhalation: A chronic, productive cough (bronchitis) associated with breathing difficulty may occur following long-term exposure.

Skin Contact: Inflammation, pain, skin discoloration and severe burns may follow chronic exposure.

Cancer Hazard: Insufficient data exist to determine whether phosphorous oxychloride is a cancer-causing agent.

Reproductive Hazard: Information is not available to determine any reproductive effects of phosphorous oxychloride.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Not available.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 0.1 ppm, averaged over an 8-hour workshift.

ACGIH: The recommended airborne exposure limit is 0.1 ppm, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 0.5 ppm.

MEDICAL MONITORING

No specific medical monitoring is required.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Remove the individual from area to fresh air immediately. If breathing has ceased, properly trained personnel should begin cardiopulmonary resuscitation (CPR) immediately. Obtain medical attention immediately.

Ingestion: DO NOT INDUCE VOMITING. If vomiting occurs, have the person lean forward to reduce the risk of aspiration. Dilute the acid immediately by having the person drink large quantities of water. Never give anything by mouth if the person is unconscious or is losing consciousness. Get medical help immediately

Skin: Remove contaminated clothing and shoes immediately. Wash affected areas with large amounts of water and soap or mild detergent until no evidence of chemical remains (15-20 minutes). Get medical help immediately.

Eyes: Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). In case of burns, apply sterile bandages loosely without medication. Get medical help immediately.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 0	Flash Point: NA
Reactivity: 2	Extinguishing Media: Dry chemical or carbon dioxide
Health: 3	Flammable Limits: NA

Respiratory Protection: Self-contained breathing apparatus with full-facepiece, operated in pressure-demand or other positive-pressure mode.

Protective Equipment: Splash-proof goggles, faceshield, and impervious clothing should be worn to prevent contact with phosphorus oxychloride.

Special Precautions: Phosphorus oxychloride is not a flammable material. If it is present during a fire, the use of water should be avoided, because it reacts violently to form toxic hydrogen chloride and phosphorus oxides.

SPILL, LEAK, AND DISPOSAL PROCEDURES

Dig a holding area such as a pit or pond to contain a liquid spill, and dike surface flow with soil or sandbags. Absorb the liquid with fly ash or cement powder. Neutralize with sodium carbonate, lime, or crushed limestone. For an air spill, a water spray may be used to reduce vapors. The water will be corrosive and toxic, and should be diked for containment and neutralized with lime or sodium bicarbonate. Keep combustibles such as wood, paper, and oil away. Ventilate closed spaces before entering.

Respiratory Protection: Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode.

Protective Clothing: Impervious clothing (such as neoprene), including protective gloves, should be worn to prevent any possibility of skin contact.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are better than personal protective equipment. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Improper use of respirators can be dangerous. Only respirators that have been approved by NIOSH or MSHA for exposures to phosphorus oxychloride should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation.

The following respirators are recommended, ranked in order from minimum to maximum protection:

Chemical cartridge respirator with an acid gas cartridge and full facepiece.

Type C supplied-air respirator with full facepiece, operated in pressure-demand or other positive-pressure mode, or with a full facepiece, helmet, or hood operated in continuous-flow mode.

Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode.

PROTECTIVE EQUIPMENT

Eye Protection: Splash-proof safety goggles and a faceshield should be worn.

Clothing: Impervious clothing (such as neoprene), including protective gloves, should be worn to prevent any possibility of skin contact with phosphorus oxychloride.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Phosphorus oxychloride reacts vigorously with water and ethyl alcohol, liberating heat and corrosive fumes.

INCOMPATIBILITIES

Avoid contact with water, alcohol, combustible materials, metals, and zinc dust.

HAZARDOUS DECOMPOSITION PRODUCTS

Toxic and corrosive hydrogen chloride gas and toxic oxides of phosphorus are released by the thermal decomposition of phosphorus oxychloride.

STORAGE

Store in dry, well ventilated areas at temperatures above the freezing point (34 F). Do not store with combustible materials, especially fibrous organic materials, or with equipment that can be corroded.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 225°F (107°C)
Melting Point: 34°F (1.3°C)
Vapor Pressure: 40 mm Hg at 27°C
Specific Gravity (water = 1): 1.645

Molecular Weight: 153.33
Solubility in Water: Reacts
Evaporation Rate: NA
Vapor Density: 5.3

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

The following information is available from the Massachusetts Department of Labor and Industries.

RIGHT TO KNOW INFORMATION

The Right to Know Program can answer questions about particular chemicals, training, labeling, and other Right to Know matters. Violations of the Right to Know Law should be reported to the nearest office of the Department of Labor and Industries.

PUBLIC PRESENTATIONS

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OCCUPATIONAL HEALTH AND SAFETY SERVICES

Upon recept of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

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Pittsfield (413) 445-4214

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

SULFUR DIOXIDE

Synonyms: sulfurous anhydride; sulfurous oxide
C.A.S. Number: 7446-09-5

Chemical Formula: SO_2
Date Completed: 6/89

HAZARD SUMMARY

- **Sulfur dioxide can affect the body if it is inhaled or if it comes into contact with the eyes or skin.**
- **Exposure to sulfur dioxide may cause severe breathing difficulties. Very high levels may lead to death.**

GENERAL DESCRIPTION

Sulfur dioxide is a colorless gas at room temperature with a characteristic strong, suffocating odor. It is one of the most widely encountered contaminants in the workplace environment. It is used in the production of sulfuric acid and paper, and as a bleaching agent for sugar, fibers, and leather. It is formed whenever sulfur-containing materials are burned, as in metal smelters and in plants that burn soft coal or high-sulfur oil.

HEALTH HAZARD INFORMATION

Exposure to sulfur dioxide may occur by inhalation or by contact with the eyes or skin.

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Exposure to sulfur dioxide can irritate the eyes and respiratory tract causing burning of the eyes, tearing, choking, coughing, and chest tightness. Exposure to very high levels may cause severe breathing difficulties and may be fatal. Individuals with asthma may be at special risk for respiratory symptoms when exposed to sulfur dioxide.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #16006-6 pgs-50 cps 6/23/89
APPROVED BY: Ric Murphy, State Purchasing Agent

Skin: Contact with the liquid may cause burns, pain and redness.

Eye: Contact with sulfur dioxide may cause redness, pain and blurred vision.

Ingestion: Ingestion of the liquid may cause burning in the mouth, nausea, vomiting and irritation of the gastrointestinal tract.

CHRONIC (long-term) HEALTH EFFECTS

Inhalation: Prolonged exposure to sulfur dioxide at low levels may cause a progressive decline in lung function and lead to chronic lung disease.

Skin: Long-term exposure to liquid sulfur dioxide may cause inflammation.

Eye: Long-term exposure to sulfur dioxide may cause conjunctivitis.

Ingestion: Not available.

Cancer Hazard: Some studies of occupational groups exposed to sulfur dioxide and certain other substances have shown high rates of lung cancer. However, sulfur dioxide itself has not been proven to be a carcinogen.

Reproductive Hazard: In a limited number of studies, sulfur dioxide given to pregnant rodents has caused developmental abnormalities and reduced weight gain in the offspring. Information is lacking to determine other reproductive effects.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Individuals with asthma or other respiratory diseases may be adversely affected by levels of sulfur dioxide which produce no effect in the rest of the population.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations, made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 2 ppm, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 5 ppm.

ACGIH: The recommended airborne exposure limit is 2 ppm, averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit is 0.5 ppm, averaged over a 10-hour workshift.

MEDICAL MONITORING

Employees should have initial and annual medical exams including special attention to the respiratory tract and eyes.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Remove the individual from exposure area to fresh air immediately. If breathing has ceased, properly trained personnel should begin artificial respiration or cardiopulmonary resuscitation (CPR) immediately. Get medical attention immediately.

Ingestion: If person is conscious, immediately give large amounts of water or milk. Do not induce vomiting; do not use gastric lavage or emesis. If vomiting occurs, administer fluids repeatedly. Get medical attention immediately.

Skin: Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). In case of chemical burns, cover area with sterile, dry dressing. Get medical attention immediately.

Eyes: Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids until no evidence of chemical remains (at least 15 to 20 minutes). In case of burns, apply sterile bandages loosely without medication. Get medical attention immediately.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 0
Reactivity: 0
Health: 2

Flash Point: Not flammable
Extinguishing Media: Dry chemical; carbon dioxide; halon; water spray; foam
Flammable Limits: NA

Respiratory Protection: Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode. Supplied-air respirator with full facepiece, operated in pressure-demand or other positive-pressure mode, in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Protective Equipment: Impervious clothing is needed if contact with liquid sulfur dioxide is possible.

SPILL, LEAK, AND DISPOSAL PROCEDURES

The leak should be stopped if it can be done without risk. A water spray should be used to reduce vapors. The water is acidic and corrosive, and should be diked for neutralization and disposal. The area should be isolated until the gas has dispersed. Closed spaces should be ventilated before entering.

Federal law requires that a leak or spill of more than one pound of sulfur dioxide be reported to the State Emergency Response Commission, the local Fire Department, and the local Emergency Planning Committee.

Disposal: Pass the gas into an alkaline solution, such as sodium carbonate, then add calcium hypochlorite, neutralize, and flush with water.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to sulfur dioxide should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

Any of the following forms of respiratory protection may be used for sulfur dioxide at the indicated airborne levels. They are listed in order of increasing level of protection.

Airborne Concentration	Respiratory Protection
Up to 20 ppm	Any chemical cartridge respirator with a cartridge that provides protection against sulfur dioxide. A full facepiece should be used if eye irritation occurs.
Up to 100 ppm	A gas mask with a chin-style or a front or back-mounted canister that provides protection against sulfur dioxide. Any supplied-air respirator with full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.

Airborne Concentration	Respiratory Protection
Greater than 100 ppm or unknown	Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode. Type C supplied-air respirator with full-facepiece, operated in pressure-demand or other positive-pressure mode, and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

PROTECTIVE EQUIPMENT

Eye Protection: Splash-proof safety goggles. Contact lenses should not be worn. Sulfur dioxide produces an acidic solution when it comes in contact with water, such as the fluid surrounding the eye.

Clothing: Appropriate impervious clothing to prevent skin contact. There is a dual hazard of skin freezing on contact with the liquid and acid burns on contact with the wet gas.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Sulfur dioxide is stable at normal temperatures and pressures.

INCOMPATIBILITIES

Sulfur dioxide reacts explosively with oxidizing agents such as nitric acid and chlorates, with halogens, and with active metals such as sodium, aluminum, powdered chromium, and powdered manganese. Moist sulfur dioxide corrodes many metals and degrades plastic tubing.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition may release other toxic and hazardous gases.

STORAGE

Protect containers against physical damage. Store outdoors, or in a well ventilated area of noncombustible construction, in accordance with NFPA 49, Hazardous Chemicals Data, 1975.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 14°F (-10°C)
Melting Point: -104°F (-76°C)
Vapor Pressure: 2538 mmHg at 21°C
Specific Gravity: 1.5 at -10°C

Molecular Weight: 64.1
Solubility in Water: 10%; reacts
Evaporation Rate: gaseous
Vapor Density: 2.3

DEFINITIONS

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Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

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ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

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MEDICAL EVALUATION

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MASS. MA13.2: R245/2/SUL.FLU.

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

SULFURYL FLUORIDE

Synonyms: Sulfuric oxyfluoride; Vikane; Vikane fumigant
C.A.S. Number: 2699-79-8

Chemical Formula: SO_2F_2
Date Completed: 6/89

HAZARD SUMMARY

- **Sulfuryl fluoride may affect the body if it is inhaled or if it comes in contact with the skin or eyes.**
- **Animal experiments have shown that sulfuryl fluoride may cause shaking, convulsions and severe breathing difficulties when it is inhaled.**
- **Sulfuryl fluoride in its liquid form may irritate the skin and the eyes.**

GENERAL DESCRIPTION

Sulfuryl fluoride is a colorless, odorless gas that is used as a fumigant and insecticide, especially for termites, and as an intermediate in the manufacture of drugs and dyes.

HEALTH HAZARD INFORMATION

Exposure to sulfuryl fluoride may occur by inhalation, skin contact, or eye contact.

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Acute overexposure to sulfuryl fluoride may cause irritation of the upper respiratory tract, nausea, vomiting, stomach cramps, confusion, difficulty breathing and fluid accumulation in the lungs. Studies in animals have indicated that high concentrations of sulfuryl fluoride may cause shaking and convulsions.

Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

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PUBLICATION: #16004-6 pgs-50 cps 6/23/89
APPROVED BY: Ric Murphy, State Purchasing Agent

Skin Contact: May cause irritation and pain.

Eye Contact: May cause redness and blurred vision.

Ingestion: Not applicable.

CHRONIC (long-term) HEALTH EFFECTS

Inhalation: Chronic, low-level exposure may be associated with slurred speech, dizziness and difficulty walking. Animal studies have shown that repeated or prolonged exposure to sulfuryl fluoride may cause lung and kidney damage and teeth discoloration.

Skin Contact: Information is not available.

Eye Contact: Information is not available.

Ingestion: Not applicable.

Cancer Hazard: Information is not available to determine whether sulfuryl fluoride is a cancer-causing agent.

Reproductive Hazard: Information is not available to determine whether sulfuryl fluoride causes reproductive effects.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Not available.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations, made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 5 ppm, averaged over an 8-hourshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 10 ppm.

ACGIH: The recommended airborne exposure limit is 5 ppm, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 10 ppm.

MEDICAL MONITORING

Employees should have initial and annual medical exams including special attention to the respiratory and the cardiovascular systems.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Remove the individual from exposure area to fresh air immediately. If breathing has ceased, properly trained personnel should begin artificial respiration or cardiopulmonary resuscitation immediately.

Skin: In case of frostbite, warm the affected area in warm water at 107°F or wrap in blankets. Encourage the individual to exercise the affected area. Get medical help immediately.

Eyes: Wash the eyes with large amounts of water, occasionally lifting the upper and lower lids. Get medical help immediately.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 0
Reactivity: 0
Health: 3

Flash Point: Non-combustible
Extinguishing Media: Dry chemical, carbon dioxide, or halon
Flammable Limits: NA

Respiratory Protection: Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode.

Protective Equipment: No protective clothing is needed for the gas form. If contact with the liquid is possible, protective clothing, including cold-insulating gloves, is required to prevent the skin from freezing.

Special Precautions: Although sulfuryl fluoride is not flammable, storage tanks containing it may explode in a fire, releasing the toxic gas. It may decompose at high temperature, generating toxic fluorine compounds and sulfur oxides.

SPILL, LEAK, AND DISPOSAL PROCEDURES

The area of the spill or leak should be ventilated to disperse the gas. Persons without appropriate respiratory protection should be kept upwind and well removed from the source. If the flow cannot be stopped, the leaking container should be allowed to empty in a safe outdoor place.

Disposal: The gas should be directed into a soda ash-slaked lime solution to form the corresponding sodium and calcium salts. The resulting solution can be safely discharged after dilution. The precipitated calcium fluoride can be placed in a landfill. Small amounts of the gas may be safely released into the atmosphere.

EMERGENCY INFORMATION SOURCES

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PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to sulfuryl fluoride should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

The following forms of respiratory protection should be used for sulfuryl fluoride at the indicated airborne levels.

Airborne Concentration	Respiratory Protection
Up to 50 ppm	Any supplied-air respirator. Any self-contained breathing apparatus.
Up to 250 ppm	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Up to 1000 ppm	A type C supplied-air respirator with full facepiece, operated in pressure-demand or other positive-pressure mode, or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 1000 ppm or unknown	Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode. Supplied-air respirator with full-facepiece, combined with a self-contained breathing apparatus, both operated in pressure-demand or other positive-pressure mode.
Escape	Any gas mask providing protection against sulfuryl fluoride. Any escape self-contained breathing apparatus.

PROTECTIVE EQUIPMENT

Eye Protection: Splash-proof goggles and a faceshield. Contact lenses should not be worn.

Clothing: No protective clothing is needed for the gas form. If contact with the liquid is possible, appropriate protective clothing, including cold insulated gloves, should be worn to prevent freezing of the skin.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Sulfuryl fluoride is stable at normal temperatures and pressures.

INCOMPATIBILITIES

None known.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition of sulfuryl fluoride generates toxic compounds of fluorine and oxides of sulfur.

STORAGE

Keep containers in a cool, well ventilated location, protected against physical damage.

PHYSICAL AND CHEMICAL DATA

Boiling Point: -68°F (-55°C)
Melting Point: -214°F (-137°C)
Vapor Pressure: 12,000 mmHg at 21°C
Specific Gravity: 1.8 at -80°C

Molecular Weight: 102.1
Solubility in Water: 16% at 0°C
Evaporation Rate: NA
Vapor Density: 3.7

DEFINITIONS

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MASS.
MA1.3.2:
R245/2/
tin

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

TIN

Synonyms: Silver matt powder; stannum **Chemical Formula: Sn**
C.A.S. Number: 7440-31-5 **Date Completed: 04-88**

HAZARD SUMMARY

-Tin fumes or tin dust can cause chest x-ray abnormalities.
-Exposure to tin may contribute to iron deficiency anemia.

GENERAL DESCRIPTION

Tin is an odorless, dull silvery metal. It is used in the manufacture of a wide range of products, including food containers, utensils, and electronic components.

HEALTH HAZARD INFORMATION

Exposure to tin may occur by inhalation, ingestion, skin contact, and eye contact.

Tin and oxides of tin present a relatively low health hazard, although other forms of tin can cause skin, mucous membrane and respiratory irritation. Only inorganic tin and tin oxide, are covered by this bulletin.

ACUTE (short-term) HEALTH EFFECTS

Inhalation: There are no symptoms due to inhalation of tin. Lung function is not affected by inhalation of tin.

Ingestion: Ingestion of tin can cause abdominal pain, nausea, vomiting, and diarrhea.

Skin Contact: Tin and tin oxide are not known to cause skin irritation (although some salts of tin may do so).

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #15,825-7pgs-50cps 2/21/89
APPROVED BY: Ric Murphy, State Purchasing Agent

Eye Contact: Tin and tin oxide are not known to cause eye irritation (although some salts of tin may do so).

CHRONIC (long-term) HEALTH EFFECTS

Chronic inhalation of tin can cause stannosis, a condition in which there is deposition of tin in the lung. In this condition, the chest x-ray appears markedly abnormal, while lung function remains normal.

Cancer Hazard: There are no data currently available to indicate whether or not tin is a cancer-causing agent.

Reproductive Hazard: Data are inadequate to determine the reproductive effects of tin.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Exposure to tin can cause a decreased ability to absorb dietary iron, and therefore can lead to or worsen iron deficiency anemia.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 2 mg/m^3, averaged over an 8-hour workshift.

ACGIH: The recommended airborne exposure limit is 2 mg/m^3, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 4 mg/m^3.

MEDICAL MONITORING

Baseline hemoglobin and hematocrit, pulmonary function tests, and chest x-ray should be obtained prior to employment in a job where there will be tin exposure. These tests should be repeated periodically.

EMERGENCY INFORMATION

FIRST AID

Inhalation: For inhalation of large amounts of tin, immediately move patient to fresh air. Start CPR if breathing has stopped. Keep patient warm and at rest. Seek immediate medical attention.

Ingestion: If the patient is conscious, he or she should drink large amounts of water immediately, then vomiting should be induced. Seek immediate medical attention.

Skin: Wash skin immediately using soap or mild detergent and water. Remove contaminated clothing immedately. Seek medical attention if irritation persists.

Eyes: Wash eyes immediately with running water, occasionally lifting upper and lower lids for at least fifteen minutes, until no evidence of the chemical remains. Seek immediate medical attention.

FIRE AND EXPLOSION

NFPA Rating: Not Available

Flash Point: Not Applicable

Extinguishing Media: Dry sand, dry dolomite, dry graphite, sodium chloride

Flammable Limits: Not Applicable

Fire and Explosion Hazards: Tin dust may be a fire hazard when exposed to heat or flame.

Respiratory Protection: Use a self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Fire Fighting Procedures: Move container(s) from fire area, if possible.

SPILL, LEAK AND DISPOSAL PROCEDURES

Spill or Leak: Secure the spill area from entry of personnel not authorized to perform the cleanup. All cleanup personnel should wear appropriate respiratory protection and protective clothing. Collect the spilled tin in a dry container in a safe manner. The use of a high efficiency particulate air (HEPA) vacuum may be necessary.

Disposal: Dispose of inorganic tin according to all federal and state laws in a secured landfill. Recovering and recycling of tin is an alternative to disposal which should be considered.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to tin should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

Airborne Concentration	Minimum Respiratory Protection
10 mg/m^3 or less	- Any dust and mist respirator, except single-use.*
20 mg/m^3 or less	- Any dust and mist respirator, except single-use or quarter-mask respirator.* - Any fume or high efficiency particulate filter respirator.*
100 mg/m^3 or less	- A high efficiency particulate filter respirator with a full facepiece. - Any supplied-air respirator with a full facepiece, helmet or hood. - Any self-contained breathing apparatus with a full facepiece.
400 mg/m^3 or less	- A powered air-purifying respirator with a full facepiece and a high efficiency particulate filter. - A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode, or with a full facepiece, helmet or hood operated in continuous-flow mode.
Greater than 400 mg/m^3 or entry and escape from unknown concentrations	- Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

Airborne Concentration	Minimum Respiratory Protection
	- A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode, and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	- Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	- A high efficiency particulate filter respirator with a full facepiece. - Any escape self-contained breathing apparatus with a full facepiece.

* If eye irritation occurs, a full-facepiece respirator should be used.

PROTECTIVE EQUIPMENT

Eye Protection: Safety glasses, goggles or face shield may be necessary.

Clothing: Protective clothing and/or gloves should be used to avoid prolonged or repeated contact with inorganic tin.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Stable at normal temperature and pressure.

INCOMPATIBILITIES

Avoid contact of powdered tin with: chlorine, turpentine, carbon dioxide, ammonium nitrate, bromine, tellurium, copper nitrate, potassium oxide, sodium peroxide, and many fluoride compounds.

HAZARDOUS DECOMPOSITION PRODUCTS

None known.

STORAGE

Store in a cool, dry place. Store away from incompatible materials.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 2260°C (4100°F)
Melting Point: 232°C (450°F)
Vapor Pressure: 1 mmHg at 1610°C (2930°F)
Specific Gravity (water=1): 7.31
Molecular Weight: 118.69
Solubility in Water: Insoluble
Evaporation Rate: Not applicable
Vapor Density: Not applicable

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

The following information is available from the Massachusetts Department of Labor and Industries.

RIGHT TO KNOW INFORMATION

The Right to Know Program can answer questions about particular chemicals, training, labeling, and other Right to Know matters. Violations of the Right to Know Law should be reported to the nearest office of the Department of Labor and Industries.

PUBLIC PRESENTATIONS

Presentations and educational programs on occupational health or the Right to Know Law can be given for labor unions, trade associations and other groups.

OCCUPATIONAL HEALTH AND SAFETY SERVICES

Upon recept of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

The Division of Occupational Hygiene has the names of various occupational health services and occupational physicians who are board-certified. This information is available upon request.

MASSACHUSETTS DEPARTMENT OF LABOR AND INDUSTRIES

Division of Occupational Hygiene

West Newton (617) 969-7177

Division of Industrial Safety

Boston (617) 727-3460
Lawrence (617) 681-7798
New Bedford (617) 997-8263
Springfield (413) 734-1421
Worcester (617) 752-6504
Pittsfield (413) 445-4214

MASS.
MA13.2:
R245/2
toluene

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

TOLUENE

Synonyms: Methyl benzene, toluol, phenyl methane, methacide
CAS Number: 108-88-3

Chemical Formula: C_7H_8
Date Completed: 1/89

HAZARD SUMMARY

- Toluene can affect you when inhaled, or by contact with the skin or eyes.
- Toluene can cause impaired coordination and confusion. At very high levels, it may even cause death.
- Long term exposure to toluene may damage the liver and kidneys. It may cause disturbances in thinking ability and emotions which may be irreversible.
- Skin contact with toluene can cause dermatitis (dryness and scaling).
- Toluene may harm the developing fetus if a pregnant woman is exposed.

GENERAL DESCRIPTION

Toluene is a colorless liquid with an aromatic odor. It is obtained mainly from petroleum, and is used as an industrial solvent and as a raw material for the manufacture of benzene, toluene diisocyanate, TNT, dyestuffs, and many other organic compounds.

HEALTH HAZARD INFORMATION

Exposure to toluene may occur by inhalation, ingestion, skin contact, and eye contact.

ACUTE (short-term) HEALTH EFFECTS

Inhalation: At low concentrations, toluene has been shown to cause irritation of the upper respiratory tract. At levels greater than 200 ppm toluene can cause symptoms of central nervous system

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depression, including headache, impaired coordination, confusion and nausea. Significantly higher levels of exposure may cause loss of consciousness and death.

Severe, life-threatening respiratory depression and metabolic abnormalities have occurred in individual "glue and toluene sniffers".

Skin Contact: Toluene may be absorbed through unbroken skin; however, this is not usually a significant route of exposure. Skin contact with toluene can result in dryness, scaling and redness.

Eye Contact: Toluene can cause eye irritation and tearing.

CHRONIC (long-term) HEALTH EFFECTS

Long-term exposure to toluene may cause liver and kidney damage. Toluene may also cause disturbances in memory, emotions, thinking ability and coordination. These changes may be irreversible.

Prolonged and repeated skin contact may result in dermatitis.

Cancer Hazard: Toluene is not known to cause cancer.

Reproductive Hazard: When given to pregnant rodents, toluene has caused damage to the fetus, including death. In some studies, toluene has caused mutations in cells. There are a few case reports of developmental problems in the children of women exposed to toluene during pregnancy. Organic solvents as a group have been associated with birth defects (e.g., of the nervous system) in children of mothers exposed during their pregnancies.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Liver disease may be aggravated by exposure.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The permissible airborne exposure limit is 100 ppm, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 150 ppm.

ACGIH: The recommended airborne exposure limit is 100 ppm, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 15-minute period, is 150 ppm.

NIOSH: The recommended airborne exposure limit is 100 ppm, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded in any 10-minute period, is 200 ppm.

MEDICAL MONITORING

Yearly medical evaluations, including physical examination, blood count, urinalysis and liver function tests, should be performed.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Remove from exposure area to fresh air immediately. If breathing has stopped, perform artificial respiration. Keep person warm and at rest. Get medical attention immediately.

Ingestion: Extreme care must be used to prevent aspiration. Use gastric lavage with activated charcoal and a cuffed endotracheal tube within 15 minutes. In the absence of depression or convulsions or impaired gag reflex, ipecac emesis can be done. When vomiting begins, keep head below the hips to prevent aspiration. After vomiting stops, give 30-60 milliliters of fleet's phospho-soda diluted 1:4 in water. Maintain airway, blood pressure and respiration. Get medical attention. Treatment must be administered by qualified medical personnel.

Skin Contact: Remove contaminated clothing and shoes immediately. Wash affected area with soap or mild detergent and large amounts of water until no evidence of chemical remains (approximately 15-20 minutes). Get medical attention immediately.

Eye Contact: Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (approximately 15-20 minutes). Get medical attention immediately.

FIRE AND EXPLOSION

NFPA Rating

Flammability: 3
Reactivity: 0
Health: 2

Flash Point: 40°F (4°C)
Extinguishing Media: Dry chemical, carbon dioxide, water spray, or foam
Flammable Limits: lower - 1.3%, upper - 7.1%

Respiratory Protection: Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive-pressure mode. Supplied-air respirator with full facepiece, operated in pressure-demand or other positive-pressure mode, in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Protective Equipment: Impervious clothing and gloves must be worn to prevent skin contact, and splash-proof safety goggles to prevent eye contact.

Special Precautions: Toxic oxides of carbon may be formed when toluene burns.

SPILL, LEAK, AND DISPOSAL PROCEDURES

Dig a holding area such as a lagoon or pit for containment, or dike the flow with soil, sandbags, or foamed material. Use cement powder, fly ash, or a gelling agent to absorb the liquid. For a spill on water, contain with oil-spill control booms, and apply detergents or alcohols to thicken the spilled material. Shut off all ignition sources. Keep unnecessary people away. Ventilate enclosed areas. Disposal must be done in accordance with the standards given in 40 CFR 262. The EPA hazardous waste number is U220.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are almost always the best way to control employee exposure to hazardous chemicals. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to toluene should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

The following respiratory protection may be used:

Up to 1000 ppm: Any chemical cartridge respirator with organic vapor cartridges.
Any supplied-air respirator.
Any powered air-purifying respirator with organic vapor cartridges.
Any self-contained breathing apparatus.

Over 1000 ppm: Any supplied-air respirator operated in a continuous-flow mode.
Any self-contained breathing apparatus with a full facepiece.
Any supplied-air respirator with a full facepiece.
Any air-purifying full-facepiece respirator with a chin-style or front- or back-mounted organic vapor canister.

For escape: Any appropriate escape-type self-contained breathing apparatus.

PROTECTIVE EQUIPMENT

Eye Protection: Splash-proof safety goggles must be worn.

Clothing: Appropriate impervious clothing (such as Viton or Fluorine/Chloroprene), including protective gloves, must be worn to prevent repeated or prolonged skin contact with toluene.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Although toluene is stable at normal temperatures and pressures, it is flammable.

INCOMPATIBILITIES

Severe fire and explosion hazard in the presence of oxidizing agents, especially nitric acid; explosive reaction with acids, nitrogen tetroxide, bromine trifluoride, and nitromethane.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition of toluene may cause formation of toxic carbon monoxide gas.

STORAGE

Containers must be protected against physical damage, stored outside or in a detached enclosure designed for flammable liquids. No oxidizing materials should be present. Containers should meet NFPA guidelines 77-1983 for electrical grounding.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 232°F (111°C)
Melting Point: -139°F (-95°C)
Vapor Pressure: 28 mmHg @ 25°C
Specific Gravity: 0.866

Molecular Weight: 92.13
Solubility in Water: 0.05%
Evaporation Rate (Butyl acetate=1): 2.24
Vapor Density: 3.2

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

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RIGHT TO KNOW INFORMATION

The Right to Know Program can answer questions about particular chemicals, training, labeling, and other Right to Know matters. Violations of the Right to Know Law should be reported to the nearest office of the Department of Labor and Industries.

PUBLIC PRESENTATIONS

Presentations and educational programs on occupational health or the Right to Know Law can be given for labor unions, trade associations and other groups.

OCCUPATIONAL HEALTH AND SAFETY SERVICES

Upon recept of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

The Division of Occupational Hygiene has the names of various occupational health services and occupational physicians who are board-certified. This information is available upon request.

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MASS. MA13.2: R245/2/vinyl asbestos

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

VINYL ASBESTOS TILE

(sheet vinyl, asphalt tile)

GOVERNMENT DOCUMENTS COLLECTION
MAY 3 1990
University of Massachusetts Depository Copy

Synonyms (types of asbestos): actinolite, amosite, anthophylite, chrysotile, crocidolite, tremolite

Chemical Formula: Varies

C.A.S. Number (asbestos): 1332-21-4

Date Completed: 10/89

HAZARD SUMMARY

- **Asbestos is a known carcinogen - it can cause lung cancer and cancer of the lining of the lungs.**
- **Prolonged exposure can cause asbestosis, an irreversible and potentially fatal lung disease. Symptoms include difficulty breathing.**

GENERAL DESCRIPTION

Asbestos fibers have been used in floor covering products for more than 50 years. The three most common forms of asbestos floor coverings are sheet vinyl, vinyl asbestos tile and asphalt tile. Under normal conditions of use the asbestos fibers are firmly bound or locked into the non-friable matrix of the material and pose no health problems.

However, during improper installation or removal of asbestos floor coverings, asbestos fibers can be released, resulting in a heightened potential for asbestos exposure among workers on such projects and future occupants of the involved spaces.

HEALTH HAZARD INFORMATION

The primary route of exposure is inhalation. Ingestion of asbestos fibers has also been associated with cancer of the gastrointestinal tract; however, the connection has only been weakly supported by animal studies.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

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APPROVED BY: Ric Murphy, State Purchasing Agent

ACUTE (short-term) HEALTH EFFECTS

In general, asbestos has no unique short-term health effects beyond those attributed to nuisance dusts, namely irritation of the eyes, nose, and throat. The toxic effects of asbestos take many years to develop and are therefore considered long-term health effects. Asbestos-related diseases can develop many years after exposure to asbestos has ceased.

CHRONIC (long-term) HEALTH EFFECTS

Inhalation of moderate to high levels of asbestos fibers over a long period of time can cause ASBESTOSIS, a progressive, irreversible, potentially fatal lung disease, characterized by scarring of the lung tissue. Symptoms include breathlessness on exertion, non-productive coughing, and other breathing difficulties. Those symptoms usually do not appear until after the disease process is well underway. Most often, asbestos-related lung abnormalities can be detected prior to the appearance of symptoms by X-rays, and sometimes by breathing tests. Individuals who have previously been exposed to significant levels of asbestos should seek medical attention whether or not symptoms are apparent.

Brief, intense exposure to asbestos through inhalation can also cause scarring of the lining of the lungs, known as ASBESTOS-RELATED PLEURAL DISEASE. Usually, the scarring is not extensive, has no effect on lung function, and does not cause symptoms; however, on rare occasions, this scarring is very extensive and can cause breathing impairment.

Cancer Hazard:

Inhalation of asbestos fibers can cause LUNG CANCER and MESOTHELIOMA (cancer of the chest cavity linings). Lung cancer and mesothelioma are almost always fatal. Some studies suggest that asbestos may cause cancer of the larynx, gastrointestinal tract, and other sites as well. The lag time between exposure to asbestos and the onset of cancer is usually between 15 and 40 years. Statistically, the risk of cancer increases with increasing degree of asbestos exposure; however, very low exposure levels have not been proven safe.

There is a multiplicative effect of cigarette smoking and asbestos exposure on increasing the risk of developing lung cancer; therefore, on average, asbestos is more hazardous to individuals who smoke than to those who do not smoke.

Reproductive Hazard:

Very limited information is available on any reproductive effects of asbestos. One study has indicated that asbestos causes damage to the genetic material in cells in culture.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Because smoking can cause heart disease, as well as lung cancer, emphysema and other respiratory problems, asbestos exposure may worsen respiratory conditions caused by smoking. Even if you have smoked for a long time, stopping now will reduce your risk of developing health problems. For people with asbestos exposure who smoke the risk of lung cancer may be over 90 times higher than for those without either exposure.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations, made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit for all types of asbestos is .2 fibers per cubic centimeter (cc) of air, averaged over an 8-hour workshift. In addition, OSHA has standards (29 CFR 1910.1001 for general industry and 29 CFR 1926.58 for construction) with specific requirements for air monitoring, medical surveillance, engineering controls and respiratory protection.

ACGIH: The recommended airborne exposure limits for the different types of asbestos are as follows (averaged over an 8-hour workshift):

chrysotile ..... 2.0 fibers/cc
amosite ..... 0.5 fibers/cc
crocidolite .... 0.2 fibers/cc
other forms .... 2.0 fibers/cc

NIOSH: The recommended airborne exposure limit for all types of asbestos is .1 fibers per cc of air, averaged over an 8-hour workshift.

MEDICAL MONITORING

Employees who are currently exposed to asbestos at or above levels defined in the applicable standard (OSHA, 29 CFR 1910.1001, General Industry; OSHA, 29 CFR 1926.58, Construction; EPA, 40 CFR Part 763, Public Employees) must be provided with a medical monitoring program. The program should be performed by or under a physician's supervision and include the following: a medical and occupational history, a screening physical examination, pulmonary function tests, and chest x-ray. Please see the above cited standards for further details. See the above-cited standards for further details.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Remove from exposure area to fresh air immediately. If breathing has stopped, perform artificial respiration. Keep person warm and at rest. Get medical attention immediately.

Skin Contact: Remove contaminated clothing and shoes immediately. Wash affected area with soap or mild detergent and large amounts of water until no evidence of chemical remains. Get medical attention immediately.

Eye Contact: Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids until no evidence of chemical remains (approximately 15-20 minutes). Get medical attention immediately.

FIRE AND EXPLOSION

NFPA Rating: N/A
Flash Point: N/A
Extinguishing Media: Dry chemical; carbon dioxide, water spray; foam
Flammable Limits: N/A

Fire and Explosion Hazard: Negligible fire hazard when exposed to heat or flame.

Respiratory Protection: Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive-pressure mode.

Protective Equipment: Full protective clothing, including coat, pants, rubber boots and gloves normally worn by firefighters.

EMERGENCY INFORMATION SOURCES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

SAFE WORK PRACTICES - GENERAL

Work operations involving asbestos floor coverings which may result in the production of asbestos fibers must be performed in accordance with the work practice and notification requirements set forth in 453 CMR 6.00. If the contractor or property owner determines that the work can be conducted without the production of asbestos dust or asbestos fibers, the Department of Labor recommends minimum safe work practices, including the use of half-mask dual cartridge HEPA-filtered respirators and wetting prior to removal. Additional procedures to minimize exposure are listed below.

Supplies:

Stiff scraper, utility knife or hook knife, HEPA vacuum, properly labeled disposal bags, hand sprayer or sprinkling can, liquid dishwashing detergent (1 oz. in 1 gallon of water), hot air blower and hammer.

SAFE WORK PRACTICES FOR SHEET FLOOR COVERINGS

- o If necessary, remove restrictive moldings from doorways, walls, etc.
- o Cut a strip the length of the floor and about 18" wide along one wall.
- o Gently remove this strip and roll face out and securely tape so it will not unroll.
- o Place it in a properly labeled disposal bag or container.
- o Clean the exposed floor with a HEPA vacuum cleaner. If a HEPA vacuum is not available, saturate the exposed material with a detergent solution and WET SCRAPE. NEVER DRY SAND OR DRY SCRAPE. Any high spots of felt can be leveled in the same manner.
- o Repeat the process until the desired area is clean.
- o Dispose of the asbestos floor covering in an approved landfill.
- o Install the new floor covering according to the manufacturer's instructions.

SAFE WORK PRACTICES FOR RESILIENT TILES

In the case of vinyl asbestos tile, the same generic work practices apply. This includes NO DRY SANDING OR SCRAPING - only wet methods or HEPA vacuum.

- o Tiles are normally in a 9"x9" or 12"x12" dimension; the goal should be to remove the individual tiles as a complete unit.
- o In some cases, heat from the hot air blower can soften the adhesive, making removal easier.

DISPOSAL

Dispose of asbestos waste (material containing greater than 1% asbestos) according to regulations of the U.S. Environmental Protection Agency, 40 CFR Part 61, and the Massachusetts Department of Environmental Protection, 310 CMR 18.00 and 19.00.

REACTIVITY INFORMATION

REACTIVITY

Asbestos is stable and chemically non-reactive.

INCOMPATIBILITIES

Asbestos can react violently in contact with tri-N-bromomelamine, sodium hydroxide, carbon tetrachloride, chlorosulfonic acid, nitric acid, oleum, sulfuric acid, oxidizing materials and phosphorus trichloride.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition of asbestos may release acrid smoke and irritating fumes.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 2230°C (4046°F)
Melting Point: 1723°C (3134°F)
Vapor Pressure: N/A
Specific Gravity: 2.4 - 2.6

Molecular Weight: N/A
Solubility in Water: Insoluble
Evaporation Rate: N/A
Vapor Density: N/A

DEFINITIONS

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A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

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A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

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A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

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MASS.
MA13.2:
R245/21
Zinc

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

ZINC

Synonyms: blue powder, pigment black 16
CAS Number: 7440-66-6
Chemical Formula: Zn
Date Completed: 7/88

HAZARD SUMMARY

- Eye irritation may result from contact with fragments of zinc.
- Heavy exposure to zinc dust may cause cough.
- Metal fume fever, a flu-like illness, can result from breathing zinc oxide fumes.
- Zinc contains traces of other elements which may be hazardous.

GENERAL DESCRIPTION

Zinc is a soft, silvery-white metal with a blue tinge.

HEALTH HAZARD INFORMATION

Exposure to zinc can occur by inhalation and by eye contact.

ACUTE (short-term) HEALTH EFFECTS

Zinc is relatively non-toxic: it is, in fact, an essential element in the diet. When zinc is heated, however, zinc oxide fume may be generated. This can cause metal-fume fever, which is a flu-like illness (see also the Department's bulletin on zinc oxide fume). Fragments of zinc can injure the eyes. High exposure to zinc dust, like any dust, can cause coughing. Other potentially toxic metals are often found in trace amounts of zinc: arsenic,

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

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APPROVED BY: Ric Murphy, State Purchasing Agent

cadmium, manganese, lead, and possibly chromium and silver. When zinc is dissolved in acids or bases, the arsenic can become arsine which is highly toxic. When zinc is refined, cadmium is released. Cadmium is a known carcinogen. Exposure to zinc has been reported, on rare occasions, to cause an allergic skin irritation.

CHRONIC (long-term) HEALTH EFFECTS

There are no known long-term health effects due to exposure to zinc.

Cancer Hazard: Information is not currently available to determine whether zinc is a cancer-causing agent.

Reproductive Hazard: In a limited number of animal studies, certain zinc compounds have been associated with skeletal defects in the offspring. To date, there have been no reports of fetal malformations in humans exposed to zinc. There are inadequate data to determine other reproductive effects in humans.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 5 mg/m^3 (for respirable dust) and 15 mg/m^3 (for total dust), averaged over an 8-hour workshift.

ACGIH: The recommended airborne exposure limit is 5 mg/m^3 (for fume). The recommended short-term exposure limit, not to be exceeded during any 15-minute period, is 10 mg/m^3.

EMERGENCY INFORMATION

FIRST AID

Eye Contact: Flush eyes with water for at least fifteen minutes, occasionally lifting upper and lower lids. Seek immediate medical attention.

FIRE AND EXPLOSION

Zinc is a combustible solid.

NFPA Rating

Flammability: 1
Reactivity: 1
Health: 0

Flash Point: NA
Extinguishing Media: Graphite, soda ash, powdered sodium chloride
Flammable Limits: lower - 500 gm/m^3; upper - N/A

Respiratory Protection: Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure.

Special Precautions: Move container from fire area if possible. Cool containers exposed to flame with water from the side until well after the fire is out. For a massive fire in a cargo area, use unmanned hose holder or monitor nozzles; otherwise, withdraw and let fire burn. Do not use water.

SPILL, LEAK AND DISPOSAL PROCEDURES

Respiratory Protection: Supplied-air respirator with a full facepiece operated in the positive-pressure mode or with a full facepiece, hood or helmet in the continuous-flow mode; or a self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Protective Equipment: Protective clothing and gloves impervious to zinc dust; dust-proof goggles, unless full facepiece respirator is worn.

Small Spill: Flush area with flooding amounts of water.

Large Spills: Dike area for later disposal; sweep up with a minimum of dust and place in clean, dry containers. Clean up residue with a high-efficiency particulate filter vacuum.

Disposal: Dispose of zinc in accordance with federal, state and local regulations.

EMERGENCY INFORMATION SERVICES

CHEMTREC: (800) 424-9300
Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are better than personal protective equipment. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation and others. However, for some jobs (such as outside work, confined space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to zinc should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

The following respirators, listed in order of increasing respiratory protection, should be used for protection against zinc dust:

- high-efficiency particulate respirator with a full facepiece
- powered air-purifying respirator with a high-efficiency particulate filter
- supplied-air respirator with a full facepiece operated in pressure-demand or other positive-pressure mode or with a full facepiece, helmet or hood operated in continuous-flow mode.

PROTECTIVE EQUIPMENT

Eye Protection: Dust-proof goggles, when working with powder or dust, unless full facepiece respiratory protection is worn.

Clothing: Protective clothing and gloves impervious to zinc dust.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Zinc dust and powders are stable when dry, but unstable when exposed to moist air and water.

INCOMPATIBILITIES

Avoid contact with acids, alkali hydroxides, chromic anhydride, manganese chloride, chlorates, chlorine, magnesium.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition releases acrid and toxic fumes of zinc oxide.

STORAGE

Store in tightly closed containers in cool, dry and ventilated area.

PHYSICAL AND CHEMICAL DATA

Boiling Point: 907°C (1664°F)
Melting Point: 420°C (787°F)
Vapor Pressure: 1 mmHg at 487°C
Specific Gravity: 7.1

Molecular Weight: 65.38
Solubility in Water: insoluble
Evaporation Rate: NA
Vapor Density: NA

DEFINITIONS

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A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

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MEDICAL EVALUATION

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MASS.
MA13-2:
R245/2/
zinc ox.

Commonwealth of Massachusetts

RECOMMENDED SAFE PRACTICES BULLETIN

ZINC OXIDE FUME

Synonyms: Zinc white; Chinese white; flowers of zinc
CAS Number: 1314-13-2

Chemical Formula: OZn
Date Completed: 7/88

HAZARD SUMMARY

- **Exposure to zinc oxide fume occurs by inhalation.**
- **Zinc oxide fume can cause a flu-like illness called metal-fume fever.**

GENERAL DESCRIPTION

Zinc oxide fumes are white fumes formed when zinc compounds are exposed to high temperatures.

HEALTH HAZARD INFORMATION

Exposure to freshly-formed zinc oxide fume occurs by inhalation.

ACUTE (short-term) HEALTH EFFECTS

Breathing zinc oxide fumes can cause "metal-fume fever", which is a flu-like illness. It begins within hours of exposure and lasts for approximately 24 hours. Symptoms of metal-fume fever are thirst, metalic taste, headache, dry throat, cough, shortness of breath, joint and muscle achiness, fevers to 102°F or more, chills and sweats, upset stomach, nausea, fatigue, and chest pain. If there are repeated exposures to zinc oxide fumes throughout the work week, obvious symptoms will less readily occur. Upon re-exposure after a few days away from work the symptoms will reappear.

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1001 Watertown Street, West Newton, MA 02165

PUBLICATION: #15,822-5pgs-50cps 2/21/89
APPROVED BY: Ric Murphy, State Purchasing Agent

CHRONIC (long-term) HEALTH EFFECTS

There are no known chronic health effects from zinc oxide fume.

Cancer Hazard: Information is not currently available to determine whether zinc oxide fume is a carcinogen.

Reproductive Hazard: Data are inadequate to determine reproductive effects of zinc oxide fume.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 5 mg/m^3, averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit is 5 mg/m^3, averaged over a 10-hour workshift. The short-term exposure limit, not to be exceeded during any 15-minute period, is 15 mg/m^3.

ACGIH: The recommended airborne exposure limit is 5 mg/m^3, averaged over an 8-hour workshift. The short-term exposure limit, not to be exceeded any 15-minute period, is 10 mg/m^3.

MEDICAL MONITORING

There are no specific medical tests for assessing zinc oxide exposure. However, a pre-employment and periodic medical history and physical exam should be performed on all workers exposed to zinc oxide fume. All exposed workers with symptoms of a flu-like illness should be medically evaluated.

EMERGENCY INFORMATION

FIRST AID

Inhalation: Remove worker from exposure. If breathing stops, perform artificial respiration.

Eye Contact: Flush eyes with running water for at least fifteen minutes, occasionally lifting upper and lower lids. Seek medical attention if irritation persists.

Skin Contact: Remove contaminated clothing. Wash skin with soap and water.

FIRE AND EXPLOSION

NFPA Rating: NA Flash Point: NA
Extinguishing Media: Dry chemical, carbon dioxide, water spray, alcohol foam
Flammable Limits: NA

Fire and Explosion Hazards: When zinc metal is heated or burned, zinc oxide fume is produced.

Respiratory Protection: Self-contained breathing apparatus with full facepiece operated in a pressure-demand or other positive-pressure mode.

Protective Equipment: Heavy gloves and protective clothing, safety goggles and face shield.

Firefighting Procedures: Use water in flooding amounts as a fog. Cool containers with flooding amounts of water. Use water to absorb vapors. Keep upwind.

SPILL, LEAK AND DISPOSAL PROCEDURES

Restrict persons not wearing protective equipment from the area of the leak until cleanup is complete. Ventilate the area.

Respiratory Protection: Supplied-air respirator with a full facepiece operated in the positive-pressure mode, or with a full facepiece, hood or helmet in the continuous-flow mode; or a self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode.

Protective Equipment: Wear protective clothing, gloves and dust-proof goggles and face shield.

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PROTECTIVE MEASURES

ENGINEERING CONTROLS

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RESPIRATORY PROTECTION

Only respirators that have been approved by NIOSH or MSHA for exposures to zinc oxide fume should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation. Improper use of respirators can be dangerous.

PROTECTIVE EQUIPMENT

Eye Protection: Wear dust-proof goggles and face shield during welding, heating operations or other potential exposure to zinc oxide fume.

Clothing: Wear protective clothing and gloves.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Stable under normal temperatures and pressures.

INCOMPATIBILITIES

Avoid contact with chlorinated rubber, magnesium, linseed oil.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition releases acrid and toxic fumes of zinc oxide.

STORAGE

Not applicable.

PHYSICAL AND CHEMICAL DATA

Boiling Point: NA
Melting Point: over 1800°C (3272°F)
Vapor Pressure: NA
Specific Gravity (water=1): 5.6 (solid)
Molecular Weight: 81
Solubility in Water: Insoluble
Evaporation Rate: NA
Vapor Density: NA

DEFINITIONS

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